

馬先蒿屬的一个新系統(續)

鍾 朴 求

(中国科学院植物研究所)

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三. 馬先蒿的地理分佈

在專著性的工作中, 因为一个双重的理由, 地理分佈部分的注重, 是不会被認為过份的。第一个理由是在工作中这一部分的研究, 有它自己的責任要尽的, 那就是被研究的植物的現在分佈面積, 也可能涉及它們的歷史分佈。此外还有關於地理分佈的其他項目, 如所佔面積的地文特点、高度、居处, 也就是生态情形等方面的研究。但是在上述各項中的成就, 只能作为研究它的理由的一方面, 而这里还应该另外有一个很不同的方面, 那就是第二个理由; 它的研究, 應該提供一个工具, 借以把分佈的各个方面, 來与被提議的新系統中的分类安排, 作一核对, 看看兩者之間是否存在着一些相互联系; 这种联系的存在与否, 是很可以用來証明或者反証到底这个系統是否如像所声称的那样地表示着親緣关系。

至於为什么这两者之間会存在联系的呢? 那我們就必須涉及罗納尔德·戈德的忍耐性学說了。1) 这里可以把他的六条原理中的三条提出來:

“各个和每一个植物种, 僅僅能在某一个固定範圍的气候和土壤情况下生存和繁殖。

一个种的忍耐性是一个屬於种的性格, 和形态上的性格同样地为生物進化的規律和步驟所支配, 但是这两者並不一定关联。

一个大的分类單位的忍耐性是它所包含的种类的忍耐性的总和。”

我們應該心中有数那个忍耐性学說基本上是一个涉及於种的分佈, 而不很关联到种的集团的分佈的学說; 虽然上面錄出的最后一条原理, 也多少提到它對於較大的分类單位的關係。其实, 我們在这里提到它的目的, 並不是想在已經深加研究过的它的對於种的分佈的關係來增加些什么, 而是想把它的對於較高分類階層的關係的一方面加以闡明才这样做的。

照推断, 某一一定的种的忍耐性的性質, 是与進化和遺傳的規律密切和諧的; 換一句話說, 一个一

1) 罗·戈德: 有花植物的地理分佈, 二版(1953), 頁361—377

定的种的忍耐性,是由它的歷史背景塑造而成。这一忍耐性一般想來是應該暂时地穩定的,一直等到一些外面情形的变化偶然發生,或者在迁移的道路上,与一些新的环境相接触的时候为止。很明顯地,这种促使發生关联的忍耐性变化的环境变化,它自己也必須还是在这一植物的忍耐性范围之內的,虽然这种变化以后的环境,一定是会与此植物原生的环境有所区别,因为無疑地当一个变化是这样地剧烈,以至於超出这一植物的忍耐性变化度的时候,那末,这一植物会在它有时間來調整自己以適應新环境之前,已然死亡。这样就可以推想由新环境刺激而形成的忍耐性的改变,是不應該以太突然的情况發生,而很可能是以緩慢而漸進的方式進行的。按照这种理論,我們可以得到結論,在任何一個較小的分类單位中的相近种类的忍耐性,在理論上說來應該是極相近似的;而且屬於兩個相繼的,或者是相隔不太远的“進化世代”的祖先和它的后代之間,在普通情形之下,应會具有相类的忍耐性变化度。在忍耐性發生变化的情況下,它也一定会表現在,而且也會很容易地被發現於,相輔而來的垂直分佈、土壤性質和生物环境的由老至新的變異中的。而这几乎正是我們在馬先蒿屬的研究中所看到的情形。下面便是我們在研究中得到的一些成果¹⁾。

(一) 依分类次序排列的馬先蒿种的現代分佈²⁾

在研究一个屬的地理分佈的时候,种的現時分佈面積,是應該被認為有第一重要意义的,因为所有對於这一題材的其他方面,是要完全或者至少部分地依賴它做基礎的。为了在寫作中避免累贅,聰明的办法是把較大的分类單位的一般分佈趨勢和种的分佈分開來講,而把后者放在分类部分的各自的位置中;而这在所做的屬有相當大的情形下,尤應如此。虽然很清楚这一点,而且更面臨着把本屬中这样浩繁的种的分佈述說出來的難題,我还是採取了与上述的相反的一种方法,因为我相信这样做會得到对揭發出与植物分佈密切关联着的細仔点的好处,而且對於進化和迁移之間的內在关系的更深刻的了解,也是有所帮助的。

泊蘭氏是第一个嘗試將本屬分佈敘述的人。以特產百分比的統計為基礎,而以構造的分佈和顏色的分佈為輔助,他把世界分为八個特產省區,它們的名字是环極、欧洲、西伯利亞-土耳其斯坦、日本、美洲、高加索、西藏-中國本部以及喜馬拉雅-云南等省區。用同一根據,他还主張迁居是由四條經向(南北)線路進行的,那就是欧洲經向線、西伯利亞經向線、美洲經向線与日本經向線。隨此而來的,他又假定了从這些經向線線路中延伸出來的一定的投射路線。這些投射路線有些方面是与我們研究中注意到的事实不相符的,以後在適當的地方還要提及。但是這些分佈的經向線路和特產省區是可以有利地應用到我們的地理分佈的敘述中來的。下面便是各羣和亞羣中种的分佈。

1. RHIZOPHYLLUM 羣——这一互生叶的羣似乎最有可能是本屬中的最老的羣了,而它的环極省區內的原產,几乎是可以溯源的。这一羣是被分成以下兩個亞羣的:

(1) EURRHIZOPHYLLUM 亞羣——被想像作最先發生,这一亞羣在它的範圍內包含了十個

1) 在这一屬的研究中,虽然似乎難於確切的分辨,也还是可以在馬先蒿的繁殖、分化和進化里面,看出有三种不同的“世代”來。第一种就是“世代”这一字眼的通常的意思,而它的作用就是單純而簡單的繁殖;由这样生出來的后代,隸屬於与其親本相同的物种。第二种是“分化世代”,以这一名詞,我描画地意味着一种傳代的程序,由於它,物种將自己分化为相近的親緣种,由这种程序中出來的后代,常常和它們的先輩同屬於一个進化階層,虽然它們之間一定会有种的差別;例如, *P. flammea* L. — *P. Oederi* Vahl — *P. orthocoryne* Li — 等等。第三种是“進化世代”,意思就是它的作用,是生出在与它們親本的关系上牽涉到進化的差異的后代來,如像我們在后面的例中所見的一般: *P. Oederi* Vahl — *P. pseudoversicolor* H.-M. — *P. habachanensis* Bonati — *P. rhynchodonta* Franch. — 等等。

2) 我們剛收到了苏联植物誌第二十二卷,里面有許多的馬先蒿新种,因为時間关系,地理分佈部分,不再採納,拟待以後分类部分再行考慮。

以上的系。那開端的系 *Hirsutae-verae*¹⁾ 是在北極圈內為四個無齒型的種所代表。*P. flammea* L., *P. hirsuta* L. 和 *P. lanata* L. 是分佈得比較狹仄的三個種。其第一種見於格陵蘭，在新北極區內，南下經拉不拉多西至落基山的一部，南至紐芬蘭與冰島，在古北極區內，則見於拉拍蘭及斯堪的那維亞。第二種和第三種除了住居於歐洲和美洲的北極外，也見於極北的西伯利亞。但是這一羣的進化和蔓延的職責，主要由它們的一個最能繁育的近親 *P. Oederi* Vahl 所肩負，而它佔有最廣闊的分佈面積。它是散佈在極北和高山的歐洲以及極北和高山的西伯利亞。也許由於環境條件的少變，這一種在歐洲和北亞曾經很真實地保持過而且現在也還保持着它的原來的樣子。僅僅只有一個近種 *P. Albertii* Regel 在它通往西喜馬拉雅的道路上，在土耳其斯坦被遺留下來。但是當它到達了中國北部和日本之後，這一種就表示它的不穩定性在發生幾個變型如 subsp. *yezoensis* Nakai 亞種，var. *heteroglossa* Prain 變種等。然而真正的重要進化工作，是在它到了中國的西南部之後才認真地開始的。除了遺發出一個含有二種——雲南西北部與西康²⁾ 南部的 *P. corydaloides* H.-M. 和西康西部與西藏東南部 (subsp. *erecta* Tsoong) 的 *P. cryptantha* Marq. et Shaw——的 *Corydaloides* 系的旁支和幾個近種如西康的 *P. angustiflora* Limpr. f. 與雲南西北部的 *P. orthocoryne* Li 等之外，這一種在追求它自己的主要前程中進化成為雙齒型的 *Rhynchodontae* 系。這一系包含着三個種，有稜角的 *P. pseudoversicolor* H.-M. 和真正雙齒的 *P. habachanensis* Bonati 見於雲南西北部，而富有特征的多齒的 *P. rhynchodonta* Franch. 則見於雲南西北部、西康和甘肅西南部。這後面緊跟着具有稍長嘴部的 *Filiculae* 系，包括着 7 種，即甘肅南部的 *P. Potaninii* Maxim.、雲南西北部的 *P. Lecomtei* Bonati, *P. filicula* Franch. 和 *P. tsangchanensis* Franch.、西康西南部的 *P. filiculiformis* Tsoong 和 *P. takpoensis* Tsoong 以及喜馬拉雅東部和中部的 *P. Wallichii* Prain。

後面的 *Macrorhynchae* 系以具有類似 *Excelsae* 系的特小的唇部和極長的嘴部的花冠而標誌着另一旁支發展。這一系是單模式的；*P. macrorhyncha* Li 是雲南西北部的土著。從 *Filiculae* 進化而來，具有較大花部的 *Robustae* 是完全屬於東部和中部喜馬拉雅的；*P. nepalensis* Prain 是在錫金和尼泊爾東部發現的，而 *P. Daltonii* Prain, *P. robusta* Hk. f. 和 *P. Garkeana* Prain 則僅見於錫金喜馬拉雅。再後繼的是 *Macranthae* 系，含有 4 種和許多變型。它的分佈地域自生有 *P. insignis* Bonati 的西康南部和雲南西北部擴展到南面的 *P. nobilis* Bonati 的家鄉緬甸北部，東向經 *P. Scullyana* Prain 所居的西藏南部、錫金和尼泊爾以達本系現時所佔最西據點卡毛恩 (Kumaun)，那裏有 *P. Klotzschii* Hurus. (*P. macrantha* Klotz.). *Pumilliones* 系，大概是由 *Robustae* 系進化而來，是一個兩種和一大羣變型的小系。*P. Przewalskii* Maxim. 的原型和它的

- 1) 我們這裡的述說，還是依照着我們在前一次稿件中的親緣表內的排列方法，把 *Hirsutae-verae* 系放在 *Eurhizophyllum* 亞羣的發軔處，這樣就意味着這一系的範圍，包括着所有具有離心花序的種類，如 *P. flammea* L., *P. Oederi* Vahl, *P. angustiflora* Limpr. f., *P. orthocoryne* Li, *P. Albertii* Regel, *P. hirsuta* L. 和 *P. lanata* Cham. et Schl., 來和 *Hirsutae-centripetae* 系中的單種的具有向心花序的 *P. Lansdorffii* Fisch. 相比。經過很長的考慮之後，覺得上列種類中的最後兩種，不僅在一般體態上有所不同，而且，至少其中的一種具有二槽花粉粒的事實，使我有意接受泊蘭氏的見解，把這兩種另成獨立的 *Hirsutae-verae* 系，以與包含 *P. flammea* L. 和它的四個真正的近親的 *Flammeae* 系分別開來。這樣的一種看法，使得這三個系和它們各自的后裔之間的相互關係，成為如下述的樣子了：*Flammeae* 為 *Eurhizophyllum* 的祖先，*Hirsutae-verae* 很可能為 *Eu-apocladus* (*foliosae* 系) 的祖先而 *Hirsutae-centripetae* 則為 *Cladomania* (*Palustres* 系) 的祖先。隨之而來的，當然本亞羣開端處的 *Hirsutae-verae* 應該改為 *Flammeae*，而在 *Eu-apocladus* 亞羣的開端處，也應該加上 *Hirsutae-verae*；不但如此，那一亞羣的發源地，也要因此由歐洲改為環極省區了！
- 2) 中國西南的西康省，最近與四川合併，但是為了寫作的方便起見，老的西康省的名字，還是保持下來。

許多亞種佔着一個自甘肅南部和青海東北部經過西康，東達滇西北而西達西藏南部（即東喜馬拉雅山下的帕里）的分佈面積。*P. bella* Hk. f. 分佈較西，它居住在西康、錫金喜馬拉雅和西藏西部。

如像它的名稱所表示的，*Longiflorae* 是一個含有很專化了的具有長管的種類。這是這一亞羣中最繁榮的系，里面包含不下 22 種，而分佈面積也相當的廣。它的開始的中心似乎是在一個包括青海北部、甘肅中部、南部和四川北部的地區中，那里所見的，大部是具有黃色的花和不扭卷的盔部的種類，如 *P. bidentata* Maxim., *P. armata* Maxim., *P. cranolopha* Maxim., *P. decorissima* Diels., *P. chinensis* Maxim. 和 *P. longiflora* Rudolph.。在這些種類里面，*P. decorissima* 和一個 *P. cranolopha* 的變型，就是 var. *longicornuta* Prain，也在西康發生，而 *P. chinensis* 和 *P. longiflora* 則是兩個廣佈的種類；前者東向伸展到山西與河北，而後者呢，除了也在河北省發現外，更向北延伸至塞陽山脈（Sayan），自此經由杭愛山至科索湖、貝加爾和外貝加爾區域；向南呢，它的面積靠它的變種 var. *tubiformis* Tsoong 擴展到西康雲南，而後進入那偉大的山脈西向侵佔，最終達到它的現在最西的前哨，西喜馬拉雅的巴爾提斯坦。

在西康與滇西北的大量的紅花而具扭卷盔部的種類，表示這一系的最大演化中心是在這個區域內。那里共有 13 種，除了 3 種外都是紅花的。其中 6 種，就是 *P. Croizetiana* Li（黃花）、*P. Paxiana* Limpr. f.（白花）、*P. tenuituba* Li, *P. variegata* Li, *P. leptosiphon* Li 和 *P. latituba* Bonati 是在西康省發現的而最後一種最近也在不丹被見到；另外 4 種，*P. humilis* Bonati, *P. dolichantha* Bonati, *P. fastigiata* Franch. 與 *P. sigmoides* Franch. 是滇西南的種類，而還有 3 種 *P. Garnieri* Bonati（黃花）、*P. Delavayi* Franch. 和 *P. dolichosiphon* Li 是西康雲南所共有的。再向西，在錫金和尼泊爾東部 *P. siphonantha* Don 代替了雲南的 *P. Delavayi*。再有兩種就完結了本系的名單，那就是生於中喜馬拉雅自尼泊爾至西姆拉的 *P. Hookeriana* Wall. 和產在西喜馬拉雅自巴夏爾（Bashahr）至東阿富汗的 *P. punctata* Decne.。

最後的一個系，*Megalanthae*，是一般靠西分佈的。*P. pauciflora* Pennell 和 *P. megalantha* Don 是東喜馬拉雅的，前者只在不丹和錫金看到而後者則自不丹至東尼泊爾。其餘的種類則生在西喜馬拉雅，*P. Hoffmeisteri* Klotz. 自卡毛恩至查姆巴，*P. elephantoides* Benth. 自克什米爾至哈薩拉而 *P. bicornuta* Klotz. 則自德哈里遠至東阿富汗。

(2) RHIZOPHYLLIASTRUM 亞羣——這一亞羣分明是由前面一個進化而來，分別只在花數很少而常為向心的花序。在隔離的兩個經向分佈線路——歐洲的和西伯利亞的——里面，可以看到很親近的種類，大有可能都各自地從 *P. Oederi* Vahl 傳下來的。它的第一單位，*Roseae* 系包含 3 種：*P. rosea* L. 和 *P. orthantha* Griseb. 主要生在巴爾幹半島的高山上，而前一種也見於西阿爾卑斯山。*P. muscoides* Li 是屬於西康和西藏南部的。這一個無齒系的后繼者是對齒的 *Merrillianae* 系，它的單種 *P. Merrilliana* Li 見於甘肅西南部，西康東部和東不丹，顯見是直接由 *P. muscoides* 演進而來。在歐洲，這種在“無齒型”和“有喙型”之間的一環是見不到了。

跟隨而來的是有嘴的 *Asplenifoliae* 系，里面包含 7 種。在那些種中，*P. geminata* Portenschl. 和 *P. asplenifolia* Florke 是生在東阿爾卑斯的，而 *P. tsarungensis* Li, *P. Meyana* H.-M., *P. umbelliformis* Li 和 *P. Yui* Li 是長在西康和滇西北的。只有一種分佈得靠西南的是 *P. longipedicellata* Tsoong，見於不丹。這裡有一個在分類位置上不易確定的系，那就是單模式的 *Odontophorae*，而它的 *P. odontophora* Prain 是在錫金和附近的西藏境內被發現。*Paucifoliae* 是一個由 6 個有相當長的嘴部的種類合成的，而里面有 4 種是局限於雲南西北部的，這是 *P. tsangchanensis* Franch., *P. Forrestiana* Bonati, *P. yunnanensis* Franch. 和 *P. mic-*

rantha Li. 另外兩種是 *P. microcalyx* Hk. f. 和 *P. pseudoheydei* Tsoong, 前者居於西康西南部、西藏東南部和不丹, 而後者則為緬甸的特產。 *Paucifoliae* 系後面的兩個系是那單模式的、產於西康西南部 *Mychophylae* 系和見於四川西南部、西康東部和雲南西北部的 *Franchetianae* 系, 里面包括原型和幾個變型。

大花的 *Pseudomacranthae* 是一個有 3 個種的系, 里面的兩種 *P. aschistorhyncha* Marq. et Shaw 和 *P. Fletcheri* Tsoong 是生長在較小的西藏西南部分的, 而第三種 *P. Elwesii* Hk. f. 和幾個變型呢, 卻一直從滇西北經由西康南部和喜馬拉雅的西端而達錫金和西藏南部。 *Albiflorae* 系的分佈是比較靠西的。除了西康東部的 *P. tapaoensis* Tsoong 之外, 在一個大概包括上緬甸、西康南部、不丹、錫金和鄰近的西藏的區域內, 分佈着 7 個種類, 它們是 *P. rhizomatosa* Tsoong, *P. perpusilla* Tsoong, *P. Hicksii* Tsoong, *P. petrophila* Li, *P. Tayloriana* Tsoong, *P. Regeliana* Prain 和 *P. albiflora* Prain. 除了上述者外, 還有兩種是尼泊爾產的, 那是 *P. Cooperi* Tsoong 和 *P. pseudoregeliana* Tsoong. 最後還有那莖部扭卷、長嘴而且長管的 *Neolattubae* 系, 分明是 *Mychophylae* 和 *Franchetianae* 系的大大地前進了的類型, 它也只有一種, 為康東特產。

2. DOLICHOPHYLLUM 羣——這一個對生葉的羣被分為四個很小的亞羣如下:

(1) EUDOLICHOPHYLLUM 亞羣——這一個亞羣要比其他三個亞羣都要靠近 *Eurhizophyllum*. 它是由兩個各有兩種的系, 雙齒型的 *Cernuae* 和有嘴型的 *Tatsienenses* 所組合的。前一系里的 *P. cernua* Bonati 與 *P. myriantha* Li 和後一系里的 *P. tatsienensis* Maxim. 是僅限於西康南部和滇西北部的, 而後一系里的第二種 *P. chenocephala* Diels 則分佈較北, 是產在甘肅西南部和青海西北部的。

(2) BRACHYSTACHYS 亞羣——這一亞羣似乎更與 *Rhizophyllastrum* 亞羣相接近, 同是極高山上的低矮植物。那個雙齒的 *Collatae* 系有兩種, *P. Bietii* Franch. 和 *P. collata* Prain, 前者居於西康而後者則住在不丹與錫金。第二個有嘴的 *Pseudoasplenifoliae* 系是由局限於錫金喜馬拉雅的 *P. schizorhyncha* Prain 和 *P. exigua* Li 兩種所組成。

(3) DOLICHOPHYLLIASTRUM 亞羣——這第三個亞羣里面有三個系, *Atrovirides*, *Remotilobae* 和 *Sikkimenses*. 第一個系的雙齒的 *P. atroviridis* Tsoong 和 *P. Sherriffii* Tsoong 是只有西康西南部有的。第二個系的單獨的種 *P. remotiloba* H.-M. 則僅見於雲南西部。第三個系的 3 個具有較長嘴的種類分佈略寬, *P. atuntsiensis* Bonati 生雲南西北部, *P. Elliottii* Tsoong 產西康西南, 而 *P. sikkimensis* Bonati 除了與前一種同生外, 也見於錫金喜馬拉雅。

(4) DOLICHOSTACHYS 亞羣——三個系, *Pilostachyae*, *Tantalorhynchoe* 和 *Meteolorhynchoe* 合起來組成這個亞羣。第一系的 *P. pilostachya* Maxim. 與 *P. ternata* Maxim. 所有的分佈面積是在青海和甘肅(包括老寧夏省的阿拉善), 第二系的具有中長的嘴部的 *P. tantalarhynchoe* Franch. 是在雲南西北部而它的近親 *P. tantalarhynchoeides* Tsoong 則生於西康西南部。那個屬於第三系的最專化了的, 長嘴的 *P. meteolorhynchoe* Li 則僅限於麗江雪山。

3. BRACHYPHYLLUM 羣——本對生葉內的種類, 很自然地形成兩個亞羣如下:

(1) EUBRACHYPHYLLUM ——此亞羣是以四系合成的; 它們是雙齒和多齒的 *Lyratae*, 具有中長嘴部的 *Brevifoliae* 和 *Debiles* 以及長嘴的 *Integrifoliae*. *Lyratae* 系的 7 種是西康東部²和西南的 *P. stenocorys* Franch. 和 *P. polyodonta* Li, 雲南西北部的 *P. laxispica* Li 和 *P. tomentosa* Li, 和兩省共有的 *P. cymbalaria* Bonati, *P. deltoidea* Franch. 和 *P. lutescens*

Franch. (有几个类型)。只有一种稍稍分佈向西,那就是西藏南部(东喜马拉雅)的 *P. lyrata* Prain. *Brevifoliae* 系包含 6 种, 其中的 *P. verbenaeifolia* Franch., *P. Smithiana* Bonati 和 *P. Tsaii* Li 是西康和云南西北部的, *P. burmanica* Bonati 是上緬甸的而 *P. porrecta* Wall. 和 *P. brevifolia* Don 是屬於喜马拉雅的, 东起錫金西迄克什米尔。不下 15 种組成 *Debiles* 系, *P. debilis* Franch., *P. Maxonii* Bonati, *P. lamioides* H.-M. 和 *P. villosula* Franch. 是固於云南西北部的, *P. rotundifolia* C.E.C. Fisch. 是上緬甸的特產, *P. confertiflora* Prain, 那个喜马拉雅山中的 *P. villosula* 是見於西康西南、西藏南部及錫金, 其余的东喜马拉雅的种类是西康西南部的 *P. sphaerantha* Tsoong, 不丹的 *P. inconspicua* Tsoong, 西藏南部的 *P. tenuicaulis* Prain 和 *P. chumbica* Prain 和錫金的 *P. instar* Prain. 在中喜马拉雅, 有兩種 *P. domzeyensis* Tsoong 和 *P. Poluninii* Tsoong 被發現於尼泊尔。最后, 最西的据点是由分生在旁遮普和克什米尔的 *P. Heydei* Prain 和 *P. canescens* Tsoong 所佔領。那个頂極的系 *Integrifoliae* 只有一种形成两个地理类型, 在东面見於西康与云南西北部, 在西面則生於錫金和西藏南部。

(2) BRACHYPHYLLIASTRUM——这个亞羣有三个系, *Binariae*, *Pectinatifformes* 和 *Urceolatae*。那个第一系中單模式的具有短嘴的 *P. binaria* Maxim. 是四川北部的特產。第二系中較長嘴的 *P. pectinatifformis* Bonati 則為西康東部的土著, 而它的可能的先輩, 那具有較短嘴部的 *P. Komarovii* Bonati, 在被报告时没有确址的, 猜想大概是从同一地区而來。两个种連合起來組成 *Urceolatae* 系, 它們是西康東部的 *P. urceolata* Tsoong 和不丹的 *P. xylopoda* Tsoong。

4. APOCLADUS 羣——这是本屬中的最發達的羣中的一个而是互生叶的。它的种类可以归入两个亞羣如下:

(1) EU-APOCLADUS 亞羣——这一亞羣以 *Foliosae* 系¹⁾ 中的具有“無齒型”花的种类开始的, 那些可能是欧洲 *Roseae* 系的后代。在欧亞大陸上凡有 7 种。在欧洲經向分佈線上, *P. foliosa* L. 佔着西阿尔卑斯山、庇蘭尼山和鄰近的西班牙北部, *P. sumana* Spreng. 則分佈在东阿尔卑斯和阿平寧山, 而 *P. Wilhelmsiana* Fisch., *P. condensata* M. Bieb. 和 *P. atropurpurea* Nordm. 則居住在高加索、外高加索及小亞細亞的蓬塔斯地区。在东面西伯利亚經向分佈線上則僅有一种, 那就是在西伯利亚南部被記錄的 *P. sajanensis* Steph.

有三十种以上归入到后繼的双齒型的 *Comosae* 系中。它的原始中心分明是在 *Foliosae* 系的同一区域內, 但是由于緯向分佈, 它的成員就把它們的分佈面積远推到欧亞大陸的大部分去。一个次成的中心后来又在阿尔泰-天山山脉中形成, 那里的种类反比欧洲原始中心所有的更多了。那个分佈最廣的种就是与系同名的。它的分佈面積始自最西的点依不里安 (西班牙) 半島的那伐大山中。向东北, 它經由庇蘭尼山、奧凡涅山和法屬阿尔卑斯山而达意大利西部和北部的阿尔卑斯山、从这里一条支綫趋向东南至阿平寧山, 但其幹綫仍东向經由南斯拉夫的提那立克阿尔卑斯山、道拉斯山、蓬塔斯而至亞美尼亚和乔治亞。向北經過苏联中部而达烏拉尔山脉; 向南它也分佈至伊朗北部。在东西伯利亚, 它的面積是从和拿河起南下至貝加尔, 从此东向經外貝加尔至黑龍江(阿穆尔河), 为其分佈的最东点。自貝加尔向南, 伸展至柯索哥尔湖再西至阿尔泰。

其余的种类, 欧洲約有 11 种, 內中只有两种生長的地点离地中海比較远些, 它們是喀尔巴阡山东部和南部、和鄰近的烏克蘭西南部和羅馬尼亚東北部的 *P. campestris* Griseb. et Schenk, 和高加索的 *P. daghestanica* Bonati. 其余的种类中, 有兩種是分佈靠西的, 那是卡斯提尔的 *P. schizocalyx*

1) 參閱本卷頁 21 中 *Eurhizophyllum* 亞羣下的附註 1。

Lange 和卡塔羅尼亞和庇里尼山脈的 *P. asparagoides* Lapeyr. 其他 7 種為 *P. graeca* Bunge, *P. Ferdinandii* Bornm., *P. heterodonta* Panc., *P. moesiaca* Stadl., *P. leucodon* Griseb., *P. Fridrici-Augustii* Tommas 和 *P. petiolaris* Ten. 它們的總部是在巴爾幹半島, 包括一個自南面的希臘和東邊的土耳其的歐洲部分(色雷斯)開始, 經由保加利亞, 阿尔巴尼亞和南斯拉夫以達伊斯特立安半島的這樣一個面積, 雖然在它們中間的前兩種分佈得比較狹仄, 前者只在希臘而後者只在馬其頓(希臘北部, 南斯拉夫南部)發現, 而最後兩種却又延伸到意大利的雷喜阿姆和阿平寧山脈中去。

本系中的其餘種類, 亞洲大約有 18 種, 雖然其中很有一些是與歐洲共有的。有很多種類是局限在本系的顯明的第二分佈中心土耳其斯坦與阿尔泰天山山脈的中間或周圍, 這些包括阿尔泰和基爾坡斯的 *P. altaica* Steph., *P. Fedtschenkoi* Bonati 和 *P. Krylowii* Bonati, 准噶爾和土耳其斯坦的 *P. breviflora* Regel, 和土耳其斯坦及帕米爾的 *P. dubia* Fedtschenko. 除了已述及的種類外, 其他或者有很寬的分佈區, 或者它們的分佈面積是遠離中心的。正那些種類中, 只有兩種是向南分佈的, 它們是 *P. dolichorhiza* Schrenk, 自准噶爾經阿富汗至西喜馬拉雅的波爾坡脫和僅自波爾坡脫至薩斯卡的 *P. brevirostris* Pennell. 在分佈中心的東北方, 共有 8 種, 就是從帕米爾經阿尔泰至蒙古北部的 *P. achilleifolia* Steph., 在幾乎同一區域見到而且更在西面的阿拉道和東面貝加爾與外貝加爾分佈的 *P. uliginosa* Bunge, 從土耳其斯坦經由阿尔泰、蒙古至外貝加爾的 *P. flava* Pall., 自阿尔泰經貝加爾、外貝加爾至極北西伯利亞的利那河地區的 *P. rubens* Steph., 自東阿尔泰至堪察加的 *P. venusta* Schangin 和它在日本北海道的白花變型、局限在貝加爾和外貝加爾的 *P. fissa* Turcz., 朝鮮半島上特產的 *P. nigrescens* Nakai 和本州、庫頁兩島的 *P. apodochila* Maxim. 最後還有三種是既往西又往東分佈的, 那是 *P. physocalyx* Bunge, 它的分佈面積起自土耳其斯坦和阿尔泰, 東向至外貝加爾, 西向經基爾坡斯草地至烏拉爾山, 此外也在極北的西伯利亞發現, *P. lasiostachys* Bunge, 自阿尔泰稍稍東向至蒙古的烏勃沙湖 (Ubsa Nor), 但主要地是西向在高加索的達該斯坦和烏克蘭的基輔附近, 和 *P. laeta* Stev., 東邊在阿尔泰、准噶爾、蒙古北部被發現, 而西邊則經由西伯利亞草原至烏拉爾, 復沿南烏拉爾至伏爾加和頓尼次兩河流域。

那具有中長的嘴部的第三個系, *Rostratae*, 里面約包自前一系進化而來的後代凡 13 種, 幾乎全部生於歐洲。它們的分佈中心, 顯然已由前一系的巴爾幹西移至阿尔卑斯山中了, 這是從南斯拉夫北部(克羅西亞)經由奧地利, 意大利北部, 瑞士以達法國的東南部。這裡有 *P. gyroflexa* Vill., *P. Barrelieri* Reichb., *P. elongata* A. Kern., *P. rostrata* L., *P. cenisia* Gaud., *P. caespitosa* Sieber 和 *P. tuberosa* L., 雖然最後的兩種也在西班牙北部生存。除了這些種外, *P. elegans* Tenore 是只在阿平寧山脈中部發現, *P. flavissima* Gandog., *P. pyrenaica* Gay. 和 *P. mixta* Gren et Godr. 是僅見於西班牙北部的, *P. Beaumgartenii* Smk. 生於南喀爾巴阡山和特朗西爾米尼亞, 而 *P. Nordmanniana* Bunge 則生於分佈面積的東緣而在小亞細亞。

大約與 *Rostratae* 在進化位置上相近似的第四個系 *Strobilaceae*, 因為它的四種 *P. gracili-caulis* Li., *P. strobilacea* Franch., *P. pseudocephalantha* Bonati 和 *P. dichrocephala* H.-M. 均為雲南西北部的特產, 而在雲南與 *Comosae* 系中種類所佔的自帕米爾至貝加爾的一條西-南東-北向的分佈線之間的地區中, 沒有發現相近的種類而使這一亞羣發生了分佈面積間斷的現象。第五個系, 具有稍長的嘴部的 *Oliganthae* 也主要是雲南西北部的, 那里住着 *P. tahainensis* Bonati, *P. dissectifolia* Li., *P. Fengii* Li., *P. oligantha* Franch., *P. tachenensis* Bonati, *P. cephalantha* 和 *P. longipetiolata* Franch., 雖然最後兩種也在鄰近的西康境內發現。只有一種分佈得稍稍向西, 那是阿塞密的 *P. cephalanthoides* Tsoong. 那十個結合成後面一個蓋部的嘴常常

扭卷的 *Oxycarpae* 系的种, 佔着比前兩系大得很多的面積。在那些种类中, *P. subulatidens* Tsoong 是西藏南部的, *P. stenophylla* Li 和 *P. lanceifolia* Tsoong 是上緬甸的, *P. Stewardii* Li 是貴州的, *P. tibetica* Franch. 是西康的, *P. macilentia* Franch. 是云南西北部的, 而 *P. Monbeigeiana* Bonati 和 *P. oxycarpa* Franch. 並見於云南西北和西康东南。最后的有着比較靠北的分佈的是 *P. torta* Maxim. 和 *P. Davidii* Franch., 生於甘肅南部和四川北部, 而前者也見於鄂西, 后者亦生在陝南。第七个系 *Dissectae* 中的 4 种中, 有 3 种是僅見於西康的, 它們是 *P. Souliei* Franch., *P. Petitmenginii* Bonati 和 *P. sparsiflora* Bonati。再稍向东北, 可以找到最后的一种, 那是陝南和河南南部的 *P. dissecta* Pennell et Li。

那个親緣关系不清楚的單模式的 *Amplitubae* 系是云南西北部的特產。最后的一系 *Rhinanthoides* 包含兩種, *P. cyclorhyncha* Li 和 *P. rhinanthoides* Schrenk; 前者是云南西北部的特產而后者和它的几个变型是廣佈的; 原型自准噶尔下來經帕米尔而至西喜馬拉雅, 而它的其余的变型呢則从阿富汗經由全部喜馬拉雅而至云南-西康区, 再至甘肅、陝西和內蒙。

(2) PSEUDAPOCLADUS 亞羣——不像前面一亞羣一样, 而且也不像本屬中其他的羣一样, 这一亞羣在欧洲經向分佈線上几乎没有發展, 在西伯利亞和日本經向分佈線上也不很發達, 但是在美洲經向線上則變得大大進化而且十分繁榮, 在那里它又南向迁移, 超越了赤道進入南美。

按照規定, 这一亞羣包含着自最原始到最進化的六个系。第一个 *Limnogenae*, 是一个僅有 3 种的小系, 那 3 种是 *P. recutita* L. 生於从奥地利至法蘭西东部的阿尔卑斯山中, *P. limnogenae* Kerner 生於自喀尔巴阡山至希臘北部的巴尔幹半島上和產於西土耳其的奥林匹山上的 *P. olympica* Boiss.。

第二系是双齒的 *Sudeticae* 系。那个代表系的种, *P. sudetica* L. 在現時已經在三个經向分佈線的北極地区找到, 但是它的原產地似乎是欧洲中部苏台德山中¹⁾。从这一地方, 它的分佈路線擴展到拉普蘭德, 經由卡寧半島、科尔古耶夫和諾瓦森伯拉島而至北烏拉爾山。在它的亞洲的地盤中, 它是沿着葉尼塞、俄雷內克、利那、科利馬等流域以达於安那提尔河与堪察加半島; 經過了聖勞倫斯島, 進入美洲經向分佈線而达到阿拉斯加和極北的加拿大; 沿着利那河, 它也南向分佈到外貝加尔。在欧洲子午線中, 没有这一种的親屬被看到, 但是在伊朗东南部却有一种 *P. laresarensis* Bornm., 而在西伯利亞和鄰近的日本省区中, 还有五种。那是 *P. villosa* Ledeb. 見於利那及科利馬兩河流域(也在庫頁島?), 鄂霍次克和堪察加的 *P. nasuta* M. Bieb., 庫頁和北海道兩島的 *P. Koidzumiana* Tatew. et Ohwi, 从托姆斯克至外貝加尔的 *P. elata* Willd. 和在阿拉道与天山的最後一种, *P. songarica* Schrenk.。

在美洲, *P. sudetica* Willd. 分佈在阿拉斯加和極北加拿大。向南就有兩種極近的种类出生在落机山中, 一种 *P. cystopteridifolia* Rydb. 是限制於黃石地区, 而另一种 *P. scopulorum* Gray 則佔着怀俄明和科罗拉多的山地。

1) 这是沒有疑問的 *P. incarnata* Jacq. 是由 *P. recutita* L. 進化而來。但是按照 *Flammea* 型發展規律, 那在这兩者——無齒和有齒——之間, 还少着有一个有齒的階段, 而 *P. sudetica* Willd. 似乎正好补入这个缺中。而且, 这一亞羣的远入南美的分佈路線也使人想到它的开始的祖先, 是在較暖的地方發生的, 對於这, 地中海沿岸是一个合乎邏輯的答案。这里还要提請注意的就是在前面討論雜交問題的时候(卷四, 頁 141—142), 曾把 *P. recutita* L. 所在的 *Limnogenae* 系放在 *Rhizophyllum* 而把 *P. incarnata* Jacq. 放在 *Rostratae* 系歸於 *Apocladus* 群的 *Eu-apocladus* 亞羣中。現在呢, 我已經改變意見, 把 *Limnogenae* 从 *Rhizophyllum* 內提到 *Pseudapocladus* 亞羣的开端处, 而把 *P. incarnata* Jacq. 也从 *Rostratae* 系提到 *Compectae* 系里來, 以歸入於 *Pseudapocladus* 亞羣中, 如像在親緣表中所見一样。

那個第三個有嘴的 *Compactae* 系也同樣地為幾個經向分佈線所共有。在歐洲，這一系僅為一種所代表，那是生於西班牙的加里西亞和庇利尼山中的 *P. incarnata* Jacq.，也見於自法蘭西東部至奧地利北部的阿爾卑斯山中。在西伯利亞經向分佈線上，*P. compacta* Steph. 佔着一個廣泛的地區，那是從西邊的烏拉爾，東至那雷姆，東南至色陽山脈，再東至貝加爾，復南以至阿爾泰與准噶爾。*P. uncinata* Steph. 有一個很狹小的分佈面積，僅從南阿爾泰至外貝加爾。在美洲省區中，那前一系發生在落基山中的兩種進化成很多種類。這些里面有蒙塔那和懷俄明的 *P. Hallii* Rydb.，為懷俄明所獨有的 *P. lunata* Rydb. 和 *P. anaticeps* Pennell、新墨西哥哥羅龍山中的 *R. mogolionica* Greene 和自懷俄明南至科羅拉多、依塔和阿利桑那的 *P. Parryi* Gray；在西邊，它在加利福尼亞被發現。在最後提到的兩州中，還發現了兩種，那就是 *P. similis* Heller 和 *P. Howellii* Gray 分生在兩州中。在本系所佔的最南據點中生有 3 種，都局限於墨西哥的一個小面積內，那是希爾達哥的 *P. Orizabae* Cham. et Schl.、哈利斯科的 *P. Jonesii* Brand 和墨西哥(省)與瓦哈卡的 *P. mexicana* Zucc.。

兩個多少有親緣然而又不同的種類，*P. pedicellata* Bunge 和 *P. ornithorhyncha* Benth. 組成第四個 *Ornithorhynchae* 系；前一種住在西特卡島而後者的住處是在華盛頓的累尼爾山上。

本亞組中，最高的花部進化僅為新世界種類所達到，像為 *Incurvae* 和 *Surrectae* 兩系所表示的一般。那個單模式的 *P. incurva* Benth. 不僅在哥倫比亞的安提斯山上生長，而且越過赤道以達厄瓜多的克汪卡，所以已超過 *Cladomania* 羣中的 *P. Zeylonica* Benth. 的南向範圍了。後一系是以三種合成的，那是 *P. contorta* Benth.、*P. attorlensis* A. Gray 和 *P. groenlandica* Retz. 第一種的範圍是在華盛頓和俄勒岡的卡斯開德山上和愛達荷、懷俄明和蒙塔那的落基山中；第二種是在加利福尼亞州的內伐達山中。那最後的一種，是本亞羣中的較高類型中分佈得最廣的一種，是與第二種一樣地生在內伐達山，那里很可能是它的原始中心。從這裡，它向東發展到新墨西哥；東北向，它穿過西面的英屬哥倫比亞和東面的盧柏特地區與拉不拉多而最終成為格陵蘭的移民¹⁾。

5. ORTHOSIPHONIA 羣——這個對生葉的羣是本屬中最大的羣之一。以現有事實推斷，本羣一定是有兩個原始分佈中心的。一方面，在近東結集着很多的原始無齒類型，表示高加索為一個原始中心，那里的種類也許是由現有的或已然死亡了的 *Limnogenae* 系中的種類中衍生出來。這一中心，雖然在原始種類的數目上佔着優勢，然而反過來在進化上說來却是次要的，因為那里的種類對於這一方面是沒有多少進展的。另一方面，在 *P. pycnantha* Boiss. 一個似乎是本羣的真正創始者的種類，和 *P. Albertii* Regel，它的屬於 *Hirsutae-verae* 系的最可能的互生葉的前代之間的形態上的相似和分佈區域的靠近，迫使我們以西伯利亞—土耳其斯坦省區為其第二原始中心。

在分類上，這一羣是由 15 個系結合而成。这里面，那個發軔的系 *Caucasicae* 包着約 10 種。半數以上的種類是集中在近東區，那是在土耳其南部道拉斯山脈中的 *P. cadmea* Boiss. 和 *P. Jan-kae* Steining.，土耳其北部、外高加索以及伊朗北部厄爾布魯斯山中的 *P. caucasica* M. Bieb.，蓬塔斯的 *P. pontica* Boiss. 和亞美尼亞的 *P. Beaugeausii* Maxim.。

在此系的第二中心，共有 2 種，天山中部的 *P. Maximowiczii* Krasn. 和與幾個變型共佔極大面積的 *P. pycnantha* Boiss.。從它在西土耳其斯坦中心，這一種向西分佈經伊朗，在那里分出了兩個近種 *P. Mobayensii* Parsa 和 *P. Hausknechtii* Boiss.，再西而止於現在的最西點土耳其的庫提斯坦。自同一中心，它也向南分佈經阿富汗，轉向東南而入西喜馬拉雅的巴歇哈(庫那圭)，這裡

1) 參閱泊蘭氏的關於格陵蘭種類的討論(頁 43, 44)。也可參閱後文“馬先蒿的年代”一節中的討論。

標誌着現在分佈的最東點。

直接由 *Caucasicae* 進步而來是含有 7 个体态較高而無齒的種類的 *Abrotanifoliae* 系。可能為本系的主幹的 *P. abrotanifolia* M. Bieb. 是以兩個型代表的, var. *altaica* 和 var. *mongolica* Maxim.; 前者自阿拉道北至阿爾泰, 再轉向西北, 在烏拉爾可以見到, 後一個則住於蒙古的杭愛山和科索哥爾湖附近地區。第一種的一個近親 *P. leptorhiza* Rupr. 是見於阿爾泰、天山及西土耳其斯坦(馬吉蘭)。在天山的科克蘇谷中, 有一種 *P. tenuicalyx* Tsoong。在南阿爾泰還有一種和 *P. abrotanifolia* 相親的 *P. moschata* Maxim.。除了這些生得比較靠北的種類外¹⁾, 其餘的種類所佔地域是很靠南的。*P. brevilabris* Franch. 是生於四川西北部和西康東部的; *P. obscura* Bonati 為雲南西北部特產, 以及 *P. densispica* Franch., 它的原型是雲南北部、四川南部和西康西南部產的, 而它的亞種 subsp. *Schneideri* (Bonati) Tsoong 則產在西康西南和雲南西北部。這同一類型的在拉薩發現, 和在宮布地區的另一新型 subsp. *viridescens* Tsoong 表示這一種不但還在向西發展, 而且還在活動地演化中。在東喜馬拉雅, 有三個來源不明的系: *Gibberae*, *Denudatae* 和 *Molles* 被發現。單模式的第一系中的 *P. gibbera* Prain 和第二系中的 *P. denudata* 和 *P. polygaloides* Prain 是集中地生在錫金喜馬拉雅和極相鄰近的西藏的一部分。單模式的 *P. mollis* Wall. 的高山類型產於西藏南部的帕里附近而它原型則向東分佈至西藏東南部及不丹, 西向則到尼泊爾。

後繼的雙齒的 *Sarawschanicae* 和 *Platyrrhynchae* 系包含着 *Caucasicae* 和 *Abrotanifoliae* 兩系的各自的進步了的后代, 而它們的中心, 也在土耳其斯坦。僅僅向前了一步, *P. sarawschanica* Maxim. 幾乎只是一個雙齒的 *P. Maximowiczii* Krassn., 而它的住處已由它的種名清楚地表示出來了。至於 *Platyrrhynchae* 系內的六種之中, 只有一種 *P. Strausii* Hauskn. 是從伊朗西部來的。在土耳其斯坦, *P. pulchra* Pauls. 是帕米爾的種類, *P. platyrrhyncha* Schrenk 是基爾吉斯草原的, *P. Waldheimii* Bonati 是柯坎特的, *P. interrupta* Steph. 是斐加那的, 但也北行至阿爾泰和南阿爾泰, 而 *P. chorgossica* Regel 則屬於科爾哥斯。

有嘴的類型, 起自單模式的 *Simae* 系, 顯示 *Abrotanifoliae* 系的一個旁支; *P. sima* Maxim. 局限於甘肅西部和四川北部的。此外在西方, *Caucasicae* 系發展成一個小系 *Crassirostres*, 包含兩種, *P. Bungei* Tsihat 和 *P. crassirostris* Bunge, 而後者是以幾個類型代表的。那些都限制在高加索和外高加索。在東方, 則 *Platyrrhynchae* 系的后裔因聚成 *Myriophyllae* 系。它們共有 7 種, 佔着一個極寬的面積。分散得最廣的種類是 *P. myriophylla* Pall., *P. alaschanica* Maxim. 和 *P. Chamissonis* Stev.。第一種可能最先在准噶爾出現, 從那里它北行至西伯利亞的東阿爾泰, 賽陽山脈, 蒙古北部的科索哥爾湖, 貝加爾及外貝加爾和蒙古中部; 它的 forma *purpurea* 也在科索哥爾發現, 更在河北小五台山上看到。第二種自蒙古西部, 青海湖邊分佈至甘肅(包括以前的寧夏省); 從这里向南, 它的位置就被它的亞種 subsp. *tibetica* (Maxim.) Tsoong 所代替了, 這一亞種見於青海、阿塞克哥爾湖和西藏南部(東喜馬拉雅)的拉薩、江孜和帕里。第三種 *P. Chamissonis* 也是為兩個類型所代表, subsp. *japonica* (Miq.) Tsoong 和 subsp. *genuina* Tsoong。

- 1) *P. pilostachya* 和 *P. ternata* Maxim. 是兩個從前放在 *Abrotanifoliae* 系中的種, 但是因為它們的葉子和體態, 一方面和 *Hirsutae-verae* 中的種類相像, 另一方面又與 *P. tantalarhyncha* Franch. 和 *P. meteorhyncha* Li 近似, 所以我就把它和前面所說的兩種合成為 *Dolichophyllum* 屬中的一個亞屬 *Dolichostachys*。現在看到 *Abrotanifoliae* 系地理分佈上的間斷——在阿爾泰-天山和四川北部之間地區的缺少種類——這也許更合理些把它們仍舊放在 *Abrotanifoliae* 系內像其他作者所做的一樣; 這樣做時, 它們就能以它們的所佔分佈面積 (*P. ternata* Maxim.: 蒙古南部, 青海, 甘肅西部; *P. pilostachya* Maxim.: 青海東部及甘肅西部) 來作為連接的環節來充滿這一系內面積的不連續性了。

那個原型分佈區是從堪察加和千島羣島開始的，東向經由阿留申羣島而到阿拉斯加西南部的西特喀。至於日本亞種的來源是可疑的，它的現在的分佈區是在本州的中部，和九州的中西部；它也許是由千島羣島上的原型而來；也可能是從中國北部的 *P. myriophylla* 獨立地形成的；不過無論怎樣，分佈還是有間斷的。除了這幾個廣佈種外，一個 *P. alaschanica* 的近種 *P. scolopax* Maxim. 是住在青海東北部和甘肅東部的；*P. cristatella* Pennell et Li, 生於甘肅西南部和四川北部；*P. Tatarinowii* Maxim. 和 *P. Provotii* Franch. 是中國北部各省的，前者為河北北部的特產，而後者也在內蒙和山西北部發現。

在不丹，我們看到了 *P. Ludlowiana* Tsoong, 是來歷和親緣不明的 *Ludlowianae* 系單模式的種。那個長嘴的 *Gyrorhynchae* 系是由三個極近的種 *P. Duclouxii* Bonati, *P. gyrorhyncha* Franch. 和 *P. Wangii* Li 所組成。這里面第一種是西康的而第二、第三種則屬於雲南西北部。含有約 8 種的具有更長的嘴部的 *Pectinatae* 似乎是由 *P. alaschanica* subsp. *tibetica* 進化而來。它的分佈面積在喜馬拉雅中向西推進很遠。這一系所佔最東的地点是西藏的當布省，也就是 *P. rhynchotricha* Tsoong 的家鄉。除了此種外，其他 7 種完全是西喜馬拉雅的種類。其中 *P. pectinata* Wall. 和它的幾個亞種是從庫毛恩至威爾絨脫和哈紮拉，*P. tenuirostris* Benth. 從德哈里至阿富汗邊境，*P. Stewartii* Pennell 從羗巴至哈紮拉，*P. pyramidata* Royle 由拉荷爾至赤特拉爾，*P. kashmirica* Pennell 和它的 subsp. *ornata* Pennell 從巴爾提斯坦至拉達克而它的原型則自西藏的極西部分至阿富汗東部，*P. multiflora* Pennell 生在克什米爾，最後 *P. cyrtorhyncha* Pennell 是限於赤特拉爾。

最終的一系 *Semitortae* 生有扭卷的莖部却相反地佔着比前一系向北向東的分佈區域。它的五種是西藏的(帕里並沿藏布江自拉薩至拉孜) *P. Oliveriana* Prain, 西康的 *P. muliensis* H.-M., 甘肅西部和四川北部的 *P. Roborowskii* Maxim., 甘肅西南部和青海東部的 *P. semitorta* Maxim. 和天山東部的 *P. Fetissowii* Regel.

6. SIGMANTHA 羣——似乎是从不同的來源——*Orthosiphonia* 和 *Cladomania*——而形成的，這一個對生葉羣內種類，可以分為三個亞羣如后：

(1) NOTHOSIGMANTHA 亞羣——這一個小的亞羣只有三個系，*Cheilanthesifoliae*, *Curvitubae* 和 *Tienschanicae*。第一系含着六個無齒的然而似乎微微有嘴的種類，這里面 *P. ophioccephala* Prain 是住在喜馬拉雅中部自尼泊爾至庫毛恩，*P. globifera* Hk. f. 生在錫金喜馬拉雅和鄰近的西藏，在藏布江沿岸濕草地中極普遍，而 *P. cheilanthesifolia* Schrenk 的家鄉是在阿拉道和土耳其斯坦，它的 var. *isochila* Maxim. 是在甘肅和青海。另外三種都是前面最後一種的分化種，也都生在西喜馬拉雅；它們是 *P. albida* Pennell, 自帕米爾邊境至斯正堤，*P. Svenhedinii* Pauls. 自拉達克和羗巴至巴歇哈，而 *P. purpurea* Pennell 則從克什米爾至拉荷爾。在第二系中只有兩種，那是甘肅南部和四川北部的 *P. anas* Maxim., 和在西康的它的 subsp. *tibetica* Tsoong, 以及甘肅北部和青海的 *P. curvituba* Maxim.。最後，那個第三系的單模式的 *P. tienschanica* Rupr. 的地点是在它的名稱所代表的那個山脈的西部。

(2) EUSIGMANTHA 亞羣——很不相稱地，這一亞羣的種類分配在三個系內，那是 *Plicatae*, *Verticillatae* 和 *Microchilae*。代表第一系的兩種是 *P. luteola* Li 和 *P. plicata* Maxim.; 前一種為雲南西北部的特產，而後一種的兩個亞種則見於西康、四川北部、甘肅和陝西南部。

作為本屬中的一個較小的分類單位，那第二個系 *Verticillatae*，似乎是最為性質龐雜的了，因為它的所含分子顯明地不是同一系統傳下來的。它的種類多至 30 種。也許是由前一系的種類中發生

出來, *P. rupicola* Franch. 似为本系中最原始的种类了。它的分佈面積, 連它的 subsp. *zambalensis* 在內, 是在云南西北部和西康南部。在前面一个地区中, 还有 5 种, 那是 *P. likiangensis* Franch., *P. brachycrania* Li, *P. glabrescens* Li, *P. lineata* Franch. 和 *P. Roylei* Maxim., 这里面的最后第二种也在上緬甸和西康發現, 而最后的一种則一直沿喜馬拉雅山西向至哈基拉为止。在上面所說的兩極端之間, 我們有庫毛恩附近的阿尔摩拉的 *P. nodosa* Pennell, 尼泊尔的 *P. nana* C. E. C. Fisch. 和 *P. rupicoides* Nakao, 錫金及鄰近的西康南部的 *P. diffusa* Prain 和西康西南部的 *P. stenotheca* Tsoong。在北面, 西康加上青海, 四川北部和甘肅, 合成一个区域, 在那里可以見到 14 种, 这些是 *P. kansuensis* Maxim. 和它的 subsp. *yargongensis* (Bonati) Tsoong, *P. tenella* Li, *P. Shawii* Tsoong, *P. pygmaea* Maxim., *P. Chingii* Bonati, *P. dolichostachya* Li, *P. multicaulis* Bonati, *P. daucifolia* Bonati, *P. involucrata* Tsoong, *P. flaccida* Prain, *P. szetschuanica* Maxim., *P. spicata* Pall. 和 *P. verticillata* L. 在这些种中, *P. kansuensis* 和 *P. szetschuanica* 两种, 現在已經西延快到西藏了, 而 *P. spicata* 也已从四川北部和甘肅經由華北、蒙古、貝加尔和外貝加尔至中國东北諸省而变成一个常見的种了。*P. verticillata* 呢, 則分佈之廣之远, 絕非它的親屬所能望其項背的, 它的范围, 几乎要等於两个廣佈的种 *P. comosa* L. 和 *P. Chamissonis* Steven 併合起來的一般大了。在亞洲, 它从它的原始中心向东至陝西、河北、南向至日本南部, 北向則放射分佈至阿尔泰、鄂尔托斯、蒙古、貝加尔和外貝加尔、东北各省, 再北至亞馬爾半島, 沿極北西伯利亞的葉尼塞、俄雷內克、利那和科利馬諸河流域分佈; 再东达鄂霍次克及堪察加, 由此經聖勞倫斯島至阿拉斯加的西特喀。在欧洲, 它的面積是連着極北西伯利亞至拉普蘭德和斯塔的那維亞, 由此南行至喀尔巴阡山脈、巴尔幹的塞那利克阿尔卑斯山、阿平寧山脈和法國阿尔卑斯和庇連尼而終达於地中海岸上的那伐达山脈中。在湖北与四川东部, 只有一种 *P. holocalyx* H.-M. 被看到。在陝西南部, 又有 *P. spicata* 的近親 *P. sparsissima* Tsoong; 另一親屬 *P. Taquetii* Tsoong 則为朝鮮的特產。在 *P. verticillata* 的北上的途中, 又發展了許多种类, 那些就是阿拉道的 *P. violascens* Schrenk, 阿拉道、阿尔泰、蒙古北部和西伯利亞南部的 *P. anthemifolia* Fisch., 堪察加和千島羣島的 *P. eriophora* Turcz. 和最后的北極地帶的 *P. amoena* Adams。这一亞羣的最末一种 *P. microchila* Franch. 是具有奇異的花冠的 *Microchilae* 系的單模式种, 生在云南西北部和西康东南部。

(3) RIGIOCAULUS 亞羣——这一个小亞羣似乎与 *Cladomania* 羣的关系最为密切。以三系組成, *Salicifoliae*, *Rigidae* 和 *Ikomanae*。第一个無齒的系中的單种是僅見於云南西北部的。双齒型的第二系里共有 6 种, 其中的 *P. rigida* Franch. 見於云南南部和北部, *P. Mairei* Bonati 僅見同省的西北部, *P. comptoniaefolia* Franch. 在西康西南部, 云南北部和西北部, 从这里又侵入上緬甸; 在那里又發現另一种 *P. atra* Bonati。在东边則有貴州特產 *P. rigidiformis* Bonati。最后的一系, 又是單模式的, 只有短嘴的 *P. Ikomanae* Sasaki 是台灣島的土著。

7. CLADOMANIA 羣——这一个小羣的成員, 是比較純一的, 所以用不到分为亞羣, 它所包含的 10 个系可以介紹如次: *Hirsutae-centripetae*, *Palustres*, *Canadenses*, *Racemosae*, *Carnosae*, *Microphyllae*, *Polyphyllatae*, *Furfuraceae* 和 *Pseudo-erostres*。这些成員中有很多是分佈極廣的, 而它們分佈到环極省区的全部的温暖补充地区。

那个唯一代表第一系的种 *P. Lansdorffii* Fisch. 在極北西伯利亞佔着一个面積, 从利那河至堪察加, 再經聖勞倫斯与阿留申而至極北美洲, 在这里它进化成双齒的 var. *hians* (Eastw.) Tsoong。第二系 *Canadenses* 是双模式的; *P. canadensis* L. 的区域是从撒喀其万与明尼托巴至諾發斯科

細亞，由此西南行至科羅拉多的落基山，在那里發生了一個新種 *P. crenulata* Benth., 但是它自己的領域則還南進至新墨西哥，東入佛羅里達。

屬於第三個 *Palustres* 系的共有很相近的 10 種。自 *P. Lansdorffii* 傳下來，*P. palustris* L. 和 *P. labradorica* Wirsing 是本系的兩個先鋒種。很像是在北極圈內出生的，前一種已經侵入歐洲的北、中和南部；在亞洲，它分佈在全部北極的和亞北極的西伯利亞，南下到蒙古、阿爾泰和准噶爾。後一種在歐洲似乎佔的面積小些，僅在斯堪的那維亞半島的一部分和北烏拉爾；在亞洲，它的地盤幾乎與前一種相等，但在南面則以貝加爾地區經外貝加爾、阿穆爾、北庫頁島及千島羣島一線為界劃。在再東面，它又經堪察加至阿拉斯加、加拿大至拉不拉多和格陵蘭。在歐洲經向分佈線上，*P. palustris* 生出 4 種來，即是 *P. sylvatica* L., *P. lusitanica* Conth., *P. gredensis* Gandog. 和 *P. numudica* Pomel. 第一種分佈較廣，自北歐至南阿爾卑斯山；第二種和第三種是在伊伯里安半島見到，而第四種則下來到阿爾及利亞而成為在非洲所見的唯一馬先蒿的種類。

在東西伯利亞，除了 *P. labradorica* 之外，尚有 1 種，為 *P. adunca* M. Bieb.¹⁾，它的遷移路線起自堪察加，南向沿鄂霍次克海岸，以達於庫頁島。在美洲，除了 *P. labradorica* 外，也還有兩種，它們是 *P. macrodontis* Richards., 生於哈德孫海灣沿岸而 *P. angustifolia* Benth. 則生於墨西哥的契瓦西南部。

第四個系 *Racemosae* 僅含少數具嘴種類，然而在地理上說來，却佔着絕大的區域。作為一個有趣的中間型來連接 *Hirsutae-centripetae* 和 *Palustres* 到 *Racemosae* 系其他種類來的是 *P. lapponica* L. 它的面積也是全北極的，在歐亞大陸上，西自挪威的多夫累，東迄安那提爾和堪察加，而它的南邊的界限則在蒙古；在美洲，它是在拉不拉多和格陵蘭被發現。分明由 *P. lapponica* L. 進化而來的是 3 種廣佈的種。在歐亞大陸上，那是 *P. resupinata* L. 和它的許多亞種和近種現在正繁榮着。那個原型的亞種自利那河上的雅庫次克開始，東向擴展至堪察加，南向經千島羣島至北海道與本州，在那里一種近種 *P. yezoensis* 被生出來；西南向，它也沿鄂霍次克海岸和斯坦諾夫治山脈至阿穆爾地區、東北各省和朝鮮半島；從雅庫次克南向，它也經由雅布羅那山脈至貝加爾和外貝加爾；自此向西，它循賽陽、阿爾泰、托姆斯克，穿過烏拉爾，以達東歐的卡馬河流域；從貝加爾以南，它經過了蒙古、內蒙和華北各省，在越過秦嶺而產生出 *P. galeobdolon* Diels 之後，止於華中各省如四川、湖北和安徽。它的最南的區域是在貴州和廣西，那里它是以 subsp. *crassicaulis* (Vnt.) Bonati 出現的。

在美洲經向分佈線上，另有兩種十分發達，那是 *P. racemosa* Dougl., 自英屬哥倫比亞南至北加利福尼亞州，和 *P. lanceolata* Michx., 分佈於加拿大和合眾國的東部。

在這一羣南面的領域內，那個黑變的體色和楔形下唇的 *Carnosae* 代替了 *Racemosae* 的位置。它的分佈中心是在雲南貴州，那里共有 7 種，*P. nigra* Bonati, *P. kouytchenensis* Bonati, *P. Gagnepainiana* Bonati, *P. Tsiangii* Li, *P. crenularis* Li, *P. crenata* Franch. 和 *P. veronicifolia* Franch., 而最後一種也見於西康東南部。從這一中心，*P. bifida* Pennell 向西經東部和中部喜馬拉雅而達西喜馬拉雅的坎格拉，而且也在阿塞密的卡細亞山中看到。向西南，在上緬甸發生了兩種，*P. Colletii* 和 *P. corymbosa* Prain; 向東南則在越南有唯一的 *P. Evrardii* Bonati。最後在德康半島的南端和錫蘭島上，可以找到 *P. zeylonica* Benth., 很可能是 *P. bifida* 的後代。

1) 因為我們圖書館中沒有 Rees Cyclopaedia 一書，所以我無法由記憶來知道 *P. pareiflora* Smith 的確切產地了。

从为 *P. tenuisecta* Franch. 所标志的在 *Microphyllae* 系中的轉折点之后,这一羣似乎以它的叶形返回到 *Palustres* 系原状而重新开始它的進化了。它的中心似乎还在云南貴州地区,那里就有3种, *P. tenuisecta* Franch., *P. Labordei* Vnt. 和 *P. Henryi* Maxim., 虽然前面两种也見於鄰近的西藏东南部而后面一种已經分佈得很远,侵入到湖北、湖南、江西、江苏、廣西和廣東諸省了。又从同一中心,分出两种去,那是 *P. flagellaris* Benth., 產上緬甸和錫金喜馬拉雅,和后面一个地点所独有的 *P. Gammieana* Prain.

緊随着 *Microphyllae* 系的是具有較長嘴部的 *Polyphyllatae*, 它的成員,除了西康西南部的 *P. Limprichtiana* H.-M. 之外,全部都是云南特產,那是 *P. Stadlmanniana* Bonati, *P. Kariensis* Bonati, *P. pinetorum* H.-M., *P. gruina* Franch. 和 *P. polyphylloides* Bonati. *Furfuraceae* 是由4种組成的一个系;它們是云南西南部的 *P. taliensis* Bonati, 西康東部的 *P. Hemsleyana* Prain, 上緬甸、尼泊尔、錫金喜馬拉雅和鄰近的西藏的 *P. Pantlingii* Prain 以及錫金和西藏南部的 *P. furfuracea* Wall. 那个單模式的 *Curvipes* 系以它的 *P. curvipes* Hk. f. 和它的亞種居於阿塞密和錫金喜馬拉雅。最后來的是那以具有特長的管部但是無嘴的 *P. Perrottettii* Benth. 为代表的 *Pseudo-erostres* 系,產在得康半島下部的尼爾坡利山中。

8. CYATHOPHORA 羣——这个有趣的对叶羣是由四个系組合的, *Reges*, *Cyathophylloides*, *Superbae* 和 *Cyathophyllae*. 第一系含有4个双齒的种,都集中在西康東部和云南西北部的一個面積內。它們是 *P. cupularis* [Li, 只在前一地址看到, *P. Lipskyana* Bonati 和 *P. thamniphila* (H.-M.) Li 是兩個省都有的,而 *P. rex* C. B. Clarke 和它的几个變型則已經从这一中心分佈到了西面的上緬甸和东喜馬拉雅的一部分,和东面的貴州,表示着这一羣的仍然很活躍的迁移。

第二系是單模式的, *P. cyathophylloides* Limpr. f. 具有一个膨大了而稍稍有嘴的盔部是局限於西康東部的种类。 *Superbae* 是第三个系,它的單模式的、花較大而嘴較長的 *P. superba* Franch. 生在云南西北部和靠近的西康南部。最后是那十分專化了的長嘴長管的 *Cyathophyllae* 系含有两种,西康東部和东南的 *P. cyathophylla* Franch. 和西康東部的 *P. connata* Li.

9. POLYSCHISTOPHYLLUM 羣——为本屬中最小的一个,这一对生叶的羣是只有兩個單模式的系,那是 *Pentagonae* 和 *Dichotomae*. 在地理上說來,那个双齒的 *P. pentagona* Li 和具有中長嘴部的 *P. dichotoma* Bonati 是只見於西康東部和云南西北部的。

10. DOLICHOMISCUS 羣——这个互生叶羣是以后面两个亞羣合成的:

(1) PTERIDIODES 亞羣——这一亞羣是以两个系, *Pteridifoliae* 和 *Phaceliaefoliae* 为基础的。前一系是單模式的, *P. pteridifolia* Bonati 是四川峨嵋山上的特產。聚合为第二系的两种分佈得寬些; *P. phaceliaefolia* Franch. 見於四川西部和云南西北部而 *P. Fargesii* Franch. 佔着較东的据点,在川东鄂西看到。

(2) EUDOLICHOMISCUS——这一亞羣在它的开端时表示了一些有趣点。一方面在欧洲的 *P. acaulis* Wulf 的存在,和它的近親 *P. Artselaeri* Maxim. 在亞洲的存在和另一方面的中間地区的缺少相近的种类,使人猜想它是一种“同祖異地”的來源,因为它的推定的祖先 *P. Sceptrum-carolinum* L. 是从北極分佈到这两个地区去了。

在分类上說來,这一亞羣是再分为六个系的。第一系, *Acaules* 含有3个無齒种。 *P. acaulis* Wulf 是見於东阿尔卑斯山的南部和第那利克阿尔卑斯山脈中,而 *P. Artselaeri* Maxim. 是生在中国北部自河北至陝西和湖北北部。后一种不像它的欧洲对手一样,表示着它的易变的性質在 var.

wutaiensis Hurus. 和在朝鮮的另一近種 *P. ishidoi* Koidz. 繼 *Acaules* 之后的第二系 *Vagantes* 是單模式的，有嘴的 *P. vagans* Hemsl. 是峨嵋山的特產。第三系 *Infirmas*，也許是 *Acaules* 系中旁支發展，有着單獨的 *P. infirma* Li，是雲南西北部的土著。第四系 *Longipedes* 是代表主要的後繼線的，里面共包 6 種；這些是湖北西部的 *P. filicifolia* Hemsl.，四川東部的 *P. nasturtiifolia* Franch.，兩省均產的 *P. laxiflora* Franch.，四川北部的 *P. longipes* Maxim.，西康雲南的 *P. axillaris* Franch. 和雲南獨有的 *P. aquilina* Bonati.

第五系的名称 *Omiianae* 自身就表明了它所包的一個種和一個亞種的產地。第六系 *Muscicola* 的中心分明是在西康，所含總數 6 種之中有 5 種是在那里發現的，那些種是 *P. gracilituba* Li, *P. sorbifolia* Tsoong, *P. geosiphon* Smith et Tsoong, *P. pseudomuscicola* Bonati 和 *P. macrosiphon* Franch.，但是里面第一種和第五種也在雲南西北部看到，而第五種更在四川被見到。第六種 *P. muscicola* Maxim. 有着最寬的面積；它的家園一直伸展到湖北、陝西、山西、甘肅(包括寧夏)和青海。第七個也是最後的一系的單模式的 *P. batangensis* Bur. et Franch. 是限制於西康境內的。

11. CYCLOCLADUS 羣——這一個對葉的羣現在已發展為三個亞羣如下：

(1) ASTHENOCAULUS 亞羣——只有兩個單模式的系組成這一小亞組，那就是雙齒的 *Fragiles* 和中長嘴部和管部的 *Flexuosae* (狹義的)；它們的單模式的種的地理分佈是分開在阿塞密和錫金喜馬拉雅，而後者在較近的時候也在不丹被看到。

(2) BRACHYCHILUS 亞羣——這一亞羣是由三系合成的，就是 *Aloenses*, *Keiskeianae* 和 *Moupinenses*，有着似乎不相連續的分佈。第一系內共有 7 種；*P. Legendrei* Bonati 是在四川東北部的，*P. Wardii* Bonati 是西康南部的，*P. aurata* (Bonati) Li 除了與前種同處外，還在雲南西北部發現，而那里更有 *P. aloensis* H.-M. *P. brachychila* Li 是上緬甸的土著，*P. Kingii* Prain 是生在錫金喜馬拉雅而 *P. Petelottii* Tsoong 則是在雲南南部靠近越南的某地採得的。

有着與前一系完全相同的體態，但是稍稍進步的花冠的是第二個系 *Keiskeianae*；*P. Kusnezowii* Komar. 是東西伯利亞阿穆爾地區北面的種類而 *P. Keiskei* Franch. et Savat. 則是日本中部本州島上產品。

(3) EUCYCLOCLADUS 亞羣——這一亞羣的分佈是比較集中的，而且完全是緯向分佈的。第一系的單種的、無齒的 *P. salviaefolia* Franch. 開始了本亞羣的進化，它的分佈現在是圍於雲南和附近的四川的一部分。自這一系進化來的是 *Melampyriflorae*, *Longicaules*, *Graciles* 和 *Coniferae*。雙齒型的 *Melampyriflorae* 嚴格地說來只含 3 種，那是西康南部與雲南西北部的 *P. melampyriflora* Franch.，西康東部和雲南西北部的 *P. pseudomelampyriflora* Bonati 和西康所獨有的 *P. floribunda* Franch.。有嘴的 *Longicaules* 只有兩種，一種是雲南北部的 *P. longicaulis* Franch.，另一種是 *P. Dielsiana* Bonati，它的產地是在中國西部，但是缺少確實地址。

長嘴的 *Graciles* 系也是由兩種組成的，雖然它所佔的面積大大地超過其餘的系併在一起。那個廣佈的 *P. gracilis* Wall. 的一個類型是它的 subsp. *stricta* (Wall.) Tsoong，它從它的原始中心雲南和西康西南部開始發展，經過整個喜馬拉雅山脈而到遠遠的阿富汗斯坦的興特托伊 (Shend-toi)。在路上經過阿塞密的時候，它發出了一個近親 *P. khasiana* Pennell，而在尼泊爾喜馬拉雅，它又在另一亞種 subsp. *genuina* Tsoong 身上，反射出它對於它的祖先 *P. salviaeflora* Franch. 的關係來。單獨地代表 *Coniferae* 系的是 *P. Conifera* Maxim.，它是一種稀少的種類，到現在為止只見於湖北西部。

12. NEOSCEPTRUM 羣——这一羣是互生叶的,含有下面两个亚羣:

(1) GEOPHYLLUM 亚羣——这一亚羣是僅以一系为其模式的,而这一系自己也是單模式的。具有双齒的 *P. hirtella* Franch. 是云南的特產。

(2) EUNEOSCEPTRUM 亚羣——这一亚羣中包括4系,那是双齒的 *Striatae*, 短的或中長嘴的 *Proboscideae* 和 *Lachnoglossae* 和那長嘴的 *Recurvae*。第一系像 *Dolichomiscus* 羣中的 *Acaules* 系一样地來表示分佈面積的不連續性,極相近的种类,各佔着美洲和亞洲的不同地区。在前一洲中,有怀俄明、科罗拉多及新墨西哥的落机山中的 *P. Grayi* A. Nelson 和美恩和加拿大的新布隆斯威克靠近的部分的 *P. Furbishiae* S. Watson。在后一洲中,有 *P. striata* Pall., 它的面積自外貝加尔南下經蒙古至華北西部的甘肅和东部的河北;还有滿洲东部和朝鮮的 *P. mandshurica* Maxim.。这些地理上远隔而親緣上很近的种类大概是在各自的地区内由靠近 *Sceptrum* 羣而又有 *Rhizophyllum* 影响的不同种但却相近的祖先中,分別地而又並行地發展而來。第二系是有嘴的 *Proboscideae*, 它是只在西伯利亞經向線上存在的;它的两种 *P. proboscidea* Stev. 和 *P. brachystachys* Bunge 主要是阿拉道和阿尔泰山系的。第三个系 *Lachnoglossae* 的独种 *P. lachnoglossa* Hk. f. 是从云南分佈到錫金喜馬拉雅。最后一系也是單模式的, *P. recurva* Maxim. 和它的 subsp. *polyantha* (Bonati) Tsoong 从甘肅西南部,經西康东北至云南西北部。

13. SCEPTRUM 羣——照推想这一羣是本屬中第二老的羣了。它也被分为两个亚羣如下:

(1) EUSCEPTRUM——这一亚羣是以下14个系合成的,这些顯然是由下面一个亚羣 *Brevilabium* 繁衍出來,而那一羣顯然是更原始。在第一个無齒型的系 *Gloriosae* 中,我們看到有一种廣佈的种,那就是 *P. Sceptrum-carolinum* L., 它的在欧洲的地盤是从北面的斯堪的那維亞半島和拉普蘭德至南面的羅馬尼亞为止;在亞洲,它散佈在北極和亞北極的西伯利亞至东面的鄂毕次克海,南面至蒙古北部、中國东北各省和日本,而在后一地区中,它又分化成許多种类。这些是本州島上的 *P. gloriosa* Bisset et Moore, *P. nipponica* Makino, *P. iwatensis* Ohwi 和九州島南的屋久島上的 *P. Ochiana* Makino。在大陸上,另一近种 *P. odontochila* Diels 是在秦嶺中被發現。第二个系是 *Grandiflorae*, 它的單独的成員 *P. grandiflora* Fisch. 是處於外貝加尔至北滿的一个地区內的。第三系的 *P. tsekouensis* Bonati 是見於西康和云南西北部的。但是最主要的系是第四个 *Tristes* 系, 它的主要的种 *P. tristis* L. 最先在东西伯利亞發生的, 从那里南下至阿尔泰、貝加尔和外貝加尔, 再下至蒙古的北部和華北的甘肅和山西, 在那里發生了 *P. shansiensis* Tsoong。在中國中部, 它的地位是被它的亞种 subsp. *macrantha* Maxim. 所代替, 这一亚种分佈在甘肅、湖北、四川西部和西康。再向南就另有一近种存在, 那是云南西北部的, 單獨地代表第五系的 *P. galeata* Bonati。

直接由前一种進化而來的是那具有舟形的和生有短嘴的蓋部的第六系中的 *P. dolichocymba* H.-M., 它的面積是限於云南西北部和西康南部。第七个系 *Rudes* 包含6种有嘴的 *Tristes* 系的后代, 它們是甘肅(包括寧夏)和四川北部的 *P. rudis* Maxim.、四川北部的 *P. decora* Franch.、西康的 *P. princeps*、西康和云南西北部的 *P. Dunniana* Bonati、上緬甸的 *P. neofischeri* Tsoong¹⁾ 和西藏南部(东喜馬拉雅)的 *P. Prainiana* Maxim.。从 *Galeatae* 系來的是第八个 *Ingentes* 系, 具有短或中長嘴部。它的8种多集中於西康省, 这是 *P. Steiningeri* Bonati, *P. pseudosteiningeri* Bonati, *P. lophotricha* Li, *P. tongolensis* Franch., *P. trichocymba* Li. 和

1) 參閱分类部分本种下的說明

P. angustiloba Tsoong. 其他兩種是青海東部和四川北部的 *P. ingens* Maxim. 和雲南西北部的 *P. pseudoingens* Bonati.

第九個系 *Imbricatae* 含有較長嘴的種類，從 *Rudes* 系進步而來，一起有 4 種。它們的中心是西移了，因為 *P. platychila* Tsoong 是阿塞密的土著，*P. imbricata* Tsoong, *P. mucronulata* Tsoong 和 *P. Clarkei* Hk. f. 都在不丹發現而最後一種更在錫金喜馬拉雅，附近的西藏境內和尼泊爾遇到。第十系 *Trichoglossae* 是有兩種從 *Dolichocymbae* 系進步而來，那是四川西南部、西康東南部和雲南西北部的 *P. rhodotricha* Maxim. 和自同一地點向西經由錫金、尼泊爾而現在已達庫毛恩的 *P. trichoglossa* Hk. f.。第十一系 *Lasiophrydes* 是以三種組成，這是散佈在青海東部、甘肅南部和四川北部的 *P. lasiophrys* Maxim. 的兩個亞種，四川西北部的 *P. craspedotricha* Maxim. 和西康的 *P. cinerescens* Franch. *Kongboenses* 是從 *Ingentes* 系直接傳下來的第十二系，內含兩個長嘴的種，*P. kongboensis* Tsoong 和 *P. retlingensis* Tsoong. 前一種是生在西康西南部而後一種稍稍向北，是在拉薩不遠處被採得的。第十三系 *Subsurrectae* 是單模式的，單獨的 *P. Vialii* Franch. 住在西康、雲南和上緬甸。第十四系 *Excelsae* 還是單模式的，*P. excelsa* Hk. f. 是東喜馬拉雅從不丹到錫金的種類。最後的也是第十五個 *Kialenses* 是具有扭曲的莖部而代表本亞羣中的最高發展的系，里面包含兩種 *P. kialensis* Franch. 和 *P. streptorhyncha* Tsoong, 二者均僅產西康。

(2) *BREVILABIUM* 亞羣——這一亞羣一定會比前一亞羣更早生存，因為在 *Sceptrum* 群中，*P. capitata* Adams 無論從地理分佈或形態特征觀點看來，都應該是最老的種類了。它的種類完全屬於新北極地區，在那里，奇異地它是沒有進化多少的。

那四個合成本亞羣的系是 *Capitatae*, *Brevilabres*, *Tripinnatae* 和 *Lunares*. 包於第一系中的是三個種，*P. capitata* Adams, *P. semibarbata* Gray 和 *P. centranthera* Gray. 那里面的第一種是廣佈於極北的西伯利亞和美洲。在前一地點，西面它到了泰米爾河而東面到達安那提爾，再從此到勘察加；再東，它在白令海峽的島上和阿留申羣島上看到，由這裡進入阿拉斯加和格陵蘭。第二和第三種的分佈區是向南很多的，前一種見於加利福尼亞的那伐達山上和東邊的那伐達州中，而後一種則見於加利福尼亞東南部、依塔南部、科羅拉多西南和新墨西哥西部等處的落基山上。

第二個系是單模式的，*P. densiflora* Benth. 是只生於加利福尼亞的。第三系的 *P. tripinnata* Mart. et Gal. 也是單模式的，是只屬於墨西哥植物區系的種類。第四個也是最大的系 *Lunares* 含有 12 種之多，而都是短或中長嘴的。第一種是僅有的本亞羣的亞洲代表，就是朝鮮半島的 *P. lunaris* Nakai. 其餘的 11 種都屬於美洲經向分佈線，而它們都住在西面的落基山上。只有兩種是在美國之外找到的，那是 *P. bracteata* Benth. 和 *P. latifolia* Pennell, 兩種均生在英屬哥倫比亞，前者東向延伸至薩斯卡徹旺，再南向入依塔和科羅拉多而後者直接南入華盛頓和愛達荷。其他 9 種，包括 *P. paddoensis* Pennell, *P. raimierensis* Pennell et Thomps., *P. atosanguinea* Pennell et Thomps., *P. Thompsonii* Pennell, *P. Canbyi* Gray, *P. siifolia* Rydb., *P. pachyrhiza* Pennell, *P. flavida* Pennell 和 *P. Paysoniana* Pennell 都沿着華盛頓、蒙塔那、愛達荷、俄勒岡和加利福尼亞的落基山中分佈。

在寫完了各羣和各亞羣的分佈之後，我們還願意在這裡提出一個表格來，使得我們對於各個大單位的分佈和其相互關係，能得到一個更直接的印象。這裡引用了三個記號，須要加以解釋的，那就是加號(+)代表為一個羣或亞羣的原始中心的省區，加減號(±)表示一個對某一羣或亞羣只有一種或少數種代表的省區，和(×)號表示一個為一羣或亞羣的最大演化中心的省區。

表示馬先蒿各屬及亞屬的分佈重要點的表格

屬	亞屬	省區	环境	歐洲	西伯利亞-土耳其斯坦	日本	美洲	高加索	西藏-中國本部	喜馬拉雅-云南
瓦 生 叶	RHIZOPHYLLUM	EURHIZOPHYLLUM	+	+	+	±			×	×
	—	RHIZOPHYLLIASTRUM		+					+	×
	APOCLADUS	EU-APOCLADUS	+	(?)	×	+		±	×	×
	—	PSEUDAPOCLADUS		+	×		×			
对 生 叶	CLADOMANIA	—	+	×	×	±	×		×	×
	DOLICHOMISCUS	PTERIDIODES							+	×
	—	EUDOLICHOMISCUS		+					+	×
	NEOSCEPTRUM	GEOPHYLLUM							+	+
叶 对 生	—	EUNEOCEPTRUM			+		+		×	×
	SCEPTRUM	EUSCEPTRUM	+	±	×	×			×	×
	—	BREVILABIUM	+				×		±	
	DOLICHOPHYLLUM	EUDOLICHOPHYLLUM							±	+
叶 对 生	—	BRACHYSTACHYS							+	×
	—	DOLICHOPHYLLIASTRUM							+	+
	—	DOLICHOSTACHYS							+	×
	BRACHYPHYLLUM	EUBRACHYPHYLLUM							+	×
叶 对 生	—	BRACHYPHYLLIASTRUM							+	×
	ORTHOSIPHONIA	—	±		+	±		+	×	×
	—	NOTHOSIGMANTHA			+				×	×
	SIGMANTHA	EUSIGMANTHA	±	±	×				+	×
叶 对 生	—	RIGIOCAULUS							×	+
	CYATHOPHORA	—							+	+
	POLYSCHISTOPHYLLUM	—							+	+
	—	ASTHENOCAULUS							+	+
叶 对 生	CYCLOCLADUS	BRACHYCHILUS			±	±			+	+
	—	EUCYCLOCLADUS							+	+

• (?)表示原始中心, 可能在环境省区, 也可能在欧洲省区。請參閱本卷頁21中 *Eurhizophyllum* 亞屬下的附註。

(二) 馬先蒿的原始中心

在介紹了在各羣和各亞羣下的種的分佈之後，我們現在可以來考慮一下那個最主要的本屬發生的原始中心在什麼地方的問題了。

以前已經提及，泊蘭氏的意見，以為馬先蒿的種類的遷移，是隨著四條經向分佈線進行的，而這些經向分佈線當然是以環極省區為本屬原始中心的這一信念為基礎的了。這一觀念在後來1918年為麗納蒂氏所接受。到了1920年，林泊利許氏却拒絕了這一意見，而提名以阿爾泰-天山山脈為本屬的搖牀；李惠林氏在他最近的修訂文中接受了這一說法。來決定這兩個相反的見解中哪個比較適當，我們一定要在各羣和各亞羣的分佈事實中來尋求解答。為了得到比較直接的觀念，我們願意將上面的很長的敘述精簡為下列各條：

1. *Rhizophyllum* 羣中的兩個亞羣是在不同的地點發生的，那就是，*Eurhizophyllum* 是在環極省區中發生的，但是它的進化為形態上較高的種類，或者換句話說，它的進化世代是遠遠地在西康-雲南地區內才開始的，在那里那個無齒的 *P. Oederi* Vahl 先進化為莖端有角的 *P. pseudoversicolor* H.-M.，再進為雙齒的 *P. habachanensis* Bonati 和那多齒短嘴的 *P. rhynchodonta* Franch.；*Rhizophylliastrum* 是分別由在歐洲和西藏-中國本部兩個省區中由 *P. Oederi* Vahl 的羣體中發生出來的，成為兩個在空間上隔離極遠的原始中心和演化中心。

2. *Scepttrum* 羣也是在環極省區中發生出來的，*Euscepttrum* 的進化是在中國中部和西南部開始的，那里最先發現那些具有舟形的短嘴的莖的種類像 *P. rudis* Maxim. 和 *P. dolichocymba* H.-M.；*Brevilabium* 的進化是在北美合眾國開始的。

3. *Cladomania* 是在環極省區內以 *P. Lansdorffii* Fisch. 的出現而開始的，而這一羣曾抓緊了時間來分化和進化，因為我們在歐洲和西伯利亞，甚至在北極地帶內，不但找到了多少雙齒的 *Palustres* 系的種類，而且也有些像 *P. lapponica* L. 和 *P. resupinata* L. 那樣的 *Racemosae* 系里的有嘴類型。

4. *Apocladus* 羣也可能是在歐洲發生的¹⁾；*Eu-apocladus* 亞羣也許是從 *Rhizophylliastrum* 亞羣中的 *Roseae* 系傳下來的，而無齒和雙齒的 *Foliosae* 和 *Comosae* 系是以緯向分佈經由吐蘭-伊朗 (Turano-Iranean) 地區和土耳其斯坦至西伯利亞，而後一系則一直東延至日本；*Pseudapocladus* 亞羣也許由 *Limnogenae* 系在歐洲開端的，後來因為 *P. sudetica* L. 在遷移上的強大能力而成為廣佈，它的子孫在西伯利亞和美洲的落基-安第斯山脈中繁衍起來。

5. *Dolichomiscus* 羣，也像 *Eurhizophyllum* 一樣，是在歐洲和亞洲各自地發生出來的，在前一地區由 *P. acaulis* Wulf 而在後一地區則由 *P. Artselaeri* Maxim.，兩者據推測都是 *P. Scepttrum-carolinum* L. 的後代；*Pteridioides* 是在中國西部發生的。

6. *Neoscepttrum* 羣的兩個亞羣，也是各別地發展出來的，*Euneoscepttrum* 是在亞洲和美洲兩地發生的，在西伯利亞和北美合眾國各為 *Striatae* 系極相關聯的種類所代表，可能都由同一親系傳下來的；*Geophyllum* 亞羣則在中國西南部出生。

7. *Orthosiphonia* 也是很有可能在兩個中心開始的，那就是高加索和阿爾泰-天山山脈；這裡可以注意到有和 *Eu-apocladus* 相同的緯向分佈的情形。

8. *Sigmantha* 羣中的3個亞羣，是不在同一地點出生的，雖然它們的花冠特征是相似的；*Notho-*

1) 參閱 *Eurhizophyllum* 亞羣下的附註，見本卷頁21。

sigmantha 是在西伯利亞-土耳其斯坦省區中出生的，部分地和 *Eu-apocladus* 和 *Orthosiphonia* 兩羣有相同的分佈面積；*Rigiocaulus* 是在喜馬拉雅-雲南省區中發生，和 *Cladomania* 羣中的有些種類的分佈相符合；*Eusigmantha* 是在西藏-中國本部省區中開始的，也可能還在喜馬拉雅-雲南省區之中。

9. 除了上面提到的包含着 10 個亞羣的 6 個互生葉和兩個對生葉的羣之外，留下來的包有 9 個亞羣的 5 個羣都是對生葉的，而它們的原始中心和演化中心都完全在中國西南部。

在上面各條中和前面表格中所表示的，我們知道在西伯利亞-土耳其斯坦省區里昇起阿爾泰-天山山脈的那個部分是主要被 *Apocladus* (*Eu-apocladus*) 和 *Orthosiphonia* 兩羣佔着優勢，而這兩個羣，具有十分明顯的緣故，是不能算作本屬中最原始之羣的。除了這兩羣的種類外，其他存在的羣則只有 *Sigmantha* 和 *Eurhizophyllum* 了。因為同樣的原因，我們對於在這地區內發現的幾種 *Sigmantha* 羣的種類，可以視為無足輕重的。對於我們因為它是前羣羣而重視它的 *Eurhizophyllum* 羣，我們只找到了兩種，那就是廣佈的 *P. Oederi* Vahl 和它的近種 *P. Albertii* Regel。至於另一前羣羣 *Sceptrum*，那麼在此範圍內連一種都找不到。

現在讓我們來看一看環極省區內的事實怎樣。對於 *Eurhizophyllum*，可以看到兩種，*P. Oederi* Vahl 和 *P. flammea* L.，還有三種疑似從雜交而來，然而還是很切近的種類，就是 *P. hirsuta* L.、*P. lanata* Cham. et Schl. 和 *P. Lansdorffii* Fisch.。對於 *Sceptrum* 呢，我們有 *P. capitata* Adams 和 *P. Sceptrum-carolinum* L.。在阿爾泰山系中一個前羣羣的完全缺如，和另一前羣羣的極少的代表種，在與北極地帶的這兩個羣有着完備的代表的生動對照之下，就差不多十分準確地告訴了我們到那裏去找 *Pedicularis* 的原始中心去了。

更有加者，這是適切的在這裏再提醒讀者關於 *Rhizophyllum* 羣花的大小的進化是確定地前進的——種類愈近代，花就愈大——這一事實。這一規律對於進化上不同的種類是準確的，而對於相近的種類或甚至於一個種下的變型中也是同樣地準確的。在現在這一事例中，我們在西藏-中國本部省區和喜馬拉雅-雲南省區中，不但有許多大花的、高度專化了的 *Rhizophyllum* 羣的種類，而且也有 *P. Oederi* Vahl 幾個花冠較大的變型，如像 var. *heteroglossa* Prain 等等。相反地，我們在北極地區和阿爾卑斯山上所見的 *P. Oederi* Vahl 却只是普通的，和在阿爾泰-天山中所見的完全相同；而且我們也不能忘記在北極的 *P. flammea* L. 生有比 *P. Oederi* Vahl 小得很多的花。當然囉，在南邊的兩省區中看到很大的花的事實，是合乎邏輯的，因為遷移和進化的趨勢是指向它們的。但是如果我們把阿爾泰-天山當作原始中心，那末，正像南邊的兩省一樣，環極和歐洲兩個省區，也將變成 *Rhizophyllum* 分佈中的次成中心了。現在在環極省區中存在着小花的 *P. flammea* L. 這一事實，就要變成在這樣一個假設的理論上的絆腳石了，因為這是很難於解說既然同為次成中心，為什麼原始的 *Rhizophyllum* 種類，南向就發生大花而北向則相反地發生小花了呢？這是十分清楚的，阿爾泰山系是不配有一個本屬中心的名稱的，就是連一個次成中心都不配；它最多也許在 *P. Oederi* Vahl 從它的在北極區的原始中心移向它的最大演化中心和進化中心的西藏-中國本部和喜馬拉雅-雲南省區的道路上的一個暫時歇足點而已，決不能再多於此了。

除了以上所說的理解之外，我們也還可以設法在生物統計中得到一些證據。泊蘭氏在他的第三表格里（構造分佈，頁 45），拿有嘴的種類來和無嘴的比較；在這種手續中，無嘴的種類就必然也包括那些具有雙齒的齒部的衍生種了。這裡就是為什麼在西伯利亞-土耳其斯坦省區中，古老種類的百分比在無意中被提高了的緣故。

為了弄明白這一點，在這裏把龐納蒂氏的八個表格（1918）簡縮成一個表格。我們沒有再費事

去把他以後所發表的種類蒐羅進來，因為覺得不包括它們也不會使這些統計變得不準確些的¹⁾。

麗氏以“進化花冠型式”與葉序為基礎，分本屬為八組，而將它們放入表格中。這些組如下：

AA=Anodontae Alternifoliae (無齒互葉組)。

BA=Bidentatae Alternifoliae (雙齒互葉組)。

RA=Rhyncholophae Alternifoliae (有喙互葉組)。

LA=Longirostres Alternifoliae (長喙互葉組)。

AV=Anodontae Verticillatae (無齒對葉組)。

BV=Bidentatae Verticillatae (雙齒對葉組)。

RV=Rhyncholophae Verticillatae (有喙對葉組)。

LV=Longirostres Verticillatae (長喙對葉組)。

雖然我們已然放棄了以“進化型式”來做我們的系統的基礎，但是上面代表麗氏的組的符號卻可以用來表示那八個顯示出本屬中清晰的前進階段的組合型式。除了代表八個組合的記號之外，還有一些編造表格所必不可少的記號被介紹進來；它們還需要說明如下：

N=各省區中所有種類的總和。

E=各省區中所有特產種類的總數。

P=各省區中特產種類的總數，對所有種類的總和的百分比， $=\left(\frac{100E}{N}\right)$

(N)=各省區中八種組合型式中的每一型式的數目。

(E)=各省區中八種組合型式中的每一型式種類的特產數目。

(P)=各省區中每一型式組合的特產種類的數目，對同一組合型式的總數的百分比，

$$=\left(\frac{100(E)}{(N)}\right)。$$

(PN)=各省區中八種組合型式中的每一型式的種類數目，對各省區內所有種類總和的百分比，

$$\left(\frac{100(N)}{N}\right)。$$

(PE)=各省區中每一組合型式的特產種數，對同一省區中所有特產種類總數的百分比，

$$=\left(\frac{100(E)}{E}\right)。$$

按表中看來，在 N 項下，環極省區在八個省區中佔着第六的位置，種的總和為 22 種，而西伯利亞-土耳其斯坦則佔第三位，有着一個 63 的種的總和。其特產種對於所有種的總和的百分比 P 則在前一省區中為 50% 而在後一省區中則為 66.7%，這無疑地是李博士以為前者作為一個省區是沒有清晰的界劃，因而拒絕以它為本屬發源地的一個重要理由（修訂第二部 239 頁）。在檢查表中 (N) 項下的 AA 時，我們看到了這兩個省區有着相同的數字，兩者均為 7 種。在 AA 中的特產種項下，這兩個省區又巧合地各具 5 種。這兩個相同的數字，使得 (P) 項下的百分數又成相等，均為 71.4。現在，如果我們反過來檢查一下 (PN) 和 (PE) 兩項下面的數字，我們就會立刻注意到前一省區在 AA 中所表示的極高的比例數來，它們達到 31.8 和 45.4 之高，而後一省區則在這方面不成比例地縮減下來，成

1) 從麗氏的文章發表以後，在環極省區內發表的種類，多屬於無齒和雙齒類型而其他省區中新發現的種類，尤其是靠南的省區中，多屬於有喙和有管類型。這很明白，把它們放進去是不會反証我們的見解而只有於它有利的。

为 11.1 和 11.9 了。这些数目肯定地表示了环极省区内最古老的無齒类型的很高的特產率¹⁾。

而且,如果我們來注意一下在(PN)項下的八个組合的数目字——那些表示各省区内,在某一進化水平上的种类数目(N),与这一省区的总和N 相对比的百分数——时,我們就不会不看到凡一个省区距环极省区愈远,那末原始类型的数目就愈小,而同时,前進类型的数目也愈大;反過來也是一样。这种古老类型向心性和專化类型的离心性决不是僅僅的一种偶然的現象;它一定表示一种事实,那就是在本屬的進化和分佈之間,保持着一种天然的和諧。

但是上面的統計所告訴我們的僅僅是馬先蒿的分佈現象而已,至於決定原始中心,主要还是要看我們怎样來解釋这些現象。在現时的植物地理学的園地里,似乎有兩個对照区別的見地。第一个是科馬罗夫²⁾的,他的研究方法曾由吳尔夫³⁾ 摘要如次:“先發現在親緣上最原始的类型,它們進化的方向,这些原始类型集中的中心,它們繼續分佈的方向”;这不过是一般的想法,以为那里是古老类型結集的中心,那里就找到了原始中心。第二个是由馬修氏⁴⁾ 提出的,要知道他的原則,我們最好引用巴李考克⁵⁾ 的話:“……从一个共同的中心,那些較老的类型放射地向四方分佈,伴隨著靠近中心的比較前進的类型的發展”,和“在某一固定的時間內,在表现出極近的親緣关系的一大羣有机体中間,那些最保守的將被發現於离原始中心最远的地方,而那些最前進的則最近中心”。

这是很明顯的,所有曾經設法或者正在設法找到馬先蒿原始中心的作者,連現在的一个計算在內,大家都在心中存着第一个,或者是科馬罗夫的,設法的要旨,而所达到的自然結果,不是归到北極圈,就是阿尔泰-天山山脈,却没有一个人曾經發生一絲一毫的以西藏-中國本部或喜馬拉雅-云南省区來作本屬原始中心的意念过。我想,至少在这里对馬先蒿屬來講,馬修氏的見地是难于应用的。

(待續)

1) 与此相关的,我們一定不要忽視了一个事实,那就是在从前的馬先蒿著作中,在决定了一种羣断的古老型式的花冠——不管它是無齒型或者是双齒型——之后,凡所有生有这样花冠的种类,都被一視同仁地作为原始,不管它們在其他形态特征上的表現如何。这明顯地是並非一个健康的办法来判断任何种类的 年代老幼。举例說吧,虽然 *P. saeviaeflora* Franch. 有着無齒的花冠,但是它已經在“它自己的身上,因为对生的叶序、分枝很多的莖等等而滯輸入一些現代性。同样的例子可以在任何一个派生的羣中找到。这意味着器部形狀所代表的价值,只是相对的,而並非絕對的。就是在同样的“無齒型”中与其他特征的不同的組合,可以代表很不同的价值。現在如果讓我們來看一下北極省区的“無齒互叶”的种类,就会很容易看出那些不但花部構造原始而且其他特征也同样地原始的种类,是集中在这里的。

2) 科馬罗夫, V. L.: 中國及蒙古植物誌的字言(聖彼得堡植物園雜誌二十九卷, 1908)。

3) 吳尔夫, E. V.: 對於歷史的植物地理之一个介紹, 第 36 頁(英譯本, 1950)。

4) 馬修, W. D.: 气候与進化, 紐約科学院年鑑二十九卷(1915), 171—318; 二版, 紐約科学院專刊, 第一卷(1939)。

5) 巴李考克, E. B.: 黃蘗菜屬, 第一部, 加利福尼亞大学植物學刊, 二十一卷(1947), 頁 125 与 75。

A NEW SYSTEM FOR THE GENUS *PEDICULARIS*

TSOONG PU-CHIU

(Institute of Botany, Academia Sinica)

(continued)

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| <p>III. Geographical Distribution of <i>Pedicularis</i>(41)</p> <p>A. The present distribution of <i>Pedicularis</i> species in systematic sequence(43)</p> <p>1. Grex RHIZOPHYLLUM ... (43)</p> <p>2. Grex DOLICHOPHYLLUM (47)</p> <p>3. Grex BRACHYPHYLLUM (48)</p> <p>4. Grex APOCLADUS(49)</p> <p>5. Grex ORTHOSIPHONIA ..(53)</p> <p>6. Grex SIGMANTHA(56)</p> <p>7. Grex CLADOMANIA(58)</p> <p>8. Grex CYATHOPHORA(60)</p> | <p>9. Grex POLYSCHISTOPHYLLUM(61)</p> <p>10. Grex DOLICHOMISCUS ..(61)</p> <p>11. Grex CYCLOCLADUS(62)</p> <p>12. Grex NEOSCEPTRUM(63)</p> <p>13. Grex SCEPTRUM(63)</p> <p>Table showing important points in the distributions of the groups and subgroups of <i>Pedicularis</i>(66)</p> <p>B. The center of origin of <i>Pedicularis</i>(67)</p> |
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III. GEOGRAPHICAL DISTRIBUTION OF *PEDICULARIS*.

In monographic works, the importance of geographic distribution can hardly be over-emphasized on a duofold reason. Of course, the study in this section of the work has its own duties to perform, i. e., the present areas of the plants concerned and possibly also their historical dispersal. In addition, there are the various other aspects in respect to plant distribution as the physiographic features of the areas occupied, the altitudinal dispersal, habitats, viz. ecological aspects etc. to be investigated. But the accomplishment in all the above phases of distribution constitutes only one facet of the reason for its study, and there should be another quite different facet; it is that its study should provide a means by which a check can be made of the various phases of distribution to the taxonomic arrangement in the new system to see if there exists any correlation between them; the presence or absence of such correlations may well serve the purpose in attesting whether the system is nearly as phyletic as it is claimed to be.

As to why there should exist such correlations, we must refer to the Theory of Tolerance of Prof. R. Good.¹⁾ Here may be quoted three out of the six principles of his theory:

"Each and every plant species is able to exist and reproduce success-

1) R. Good: The Geography of the Flowering Plants, 2nd. Edit. (1953), p. 361, et seq.

fully only within a definite range of climatic and edaphic conditions.

The tolerance of a species is a specific character subject to the laws and processes of organic evolution in the same way as its morphological characters, but the two are not necessarily linked.

The tolerance of any large taxonomic unit is the sum of the tolerances of its constituent species."

We must bear in mind the fact that the Theory of Tolerance is basically one that concerns more about the distribution of single species than collections of species, although the last principle here reproduced relates something about its tie with larger taxonomic units. Really it is not our aim to add something to its already well expounded relationships to specific distribution, but rather to reveal its other facet in relation to the higher taxa that we are referring to it now.

The nature of tolerance of any given species, as assumed, is in close concordance with the laws of evolution and genetics; in another word, it is its historical background which moulds the tolerance of any given species. This tolerance is supposed to remain temporarily static until some changes in external conditions chance to happen, or when the plant comes into contact with new environments on its tracks of dispersal. Apparently such change in external conditions which tends to stimulate a corresponding change in tolerance of a given species must itself be still within the bound of tolerance of that species, although the post-change condition must differ somehow from the original one under which the said species has subsisted, since it is obvious that a change too drastic as to be out of the tolerance variation of the species would certainly exterminate it before it has time to adapt itself to its new environments. Thus it may well be surmised that changes of tolerance through the impetus of new environments should not occur in too abrupt a manner, but would most likely happen in a slow and gradual way. By the above reasoning, we may conclude that the tolerances of closely allied species in any small taxa would theoretically be very much alike; also that the tolerances of any ancestral stocks and their offsprings belonging to two successive or not too far distant "generations of evolution"¹⁾ would, under normal conditions, retain similar amplitude in the range of tolerance. In case there is any change of tolerance, then it would surely be manifested in, and

1) In our study of the genus, there seems to be discernable, though somewhat difficult of discrimination, three different kinds of "generations" in the *multiplication, differentiation and evolution of Pedicularis*. The first is the word "generation" used in its conventional sense, and its function is pure and simple multiplication; the offsprings thus generated belong to the same species as their parent. The second is the "generation of segregation", by which I mean figuratively the kind of generative processes by which species differentiates itself into close allies; the descendants emerged from such processes appertain usually to the same evolutionary rank as, though they may differ specifically from, their progenitor; e. g., *P. flammea* L. to *P. Oederi* Vahl, *P. orthocorym* Li etc. The third is the "generation of evolution", by which it is meant that its processes generate offsprings whose relationship with their forebear involves definite evolutionary differences as what is seen in the case of four species, from *P. Oederi* Vahl through *P. pseudoversicolor* H.-M. and *P. habachanensis* Bonati to *P. rhynchodonta* Franch. etc. More discussions will be forwarded later in the subject of the area of a species and its relation to evolution.

made easily detectable from, the corresponding changes in altitudinal distribution, in those of edaphic conditions and biotic environments from the old to the new. And this is almost precisely what is found in our study of genus *Pedicularis*. In the following lines, we are going to present what a little result we have found in our investigation.

A. The present distribution of *Pedicularis* species in systematic sequence¹⁾

In the study of geographical distribution of any genus, the present areas of the species must be reckoned with as of first importance, since all other phases relating to this subject have to found their basis wholly or partly on this one. In avoiding the cumbersome effect in writing, it is wise to put forth the general trends of dispersal of the major taxa separately from the distribution of species which is better to be submitted in their respective proper positions in the systematic treatment, and this is especially true when the genus is of considerable size. Although well aware of this, and being confronted with the task in putting forth an enormous number of species in the present genus, I have still taken to the opposite method, because it is believed that in so doing, there will be the definite advantage in bringing out certain details vitally connected with plant distribution; also it will help to get a better insight into the inter-relationship between evolution and migration.

Prain was the author who first made the effort to present an account of the distribution of the genus. By basing on the statistics in endemic percentage, aided by those in the distribution by structure and in the distribution by colour, he divided the world into eight provinces of endemism, namely, Circumpolar, European, Siberio-Turkestan, Japanese, American, Caucasian, Tibeto-Chinese and Himalayo-Yunnanese. By the same token, he further asserted that the routes of migration were by four meridians, viz., the European, the Siberian, the American and the Japanese. Following this, he also postulated several definite projections for some of these meridians. These projections show in some instances clear inconsistency with the facts observed in our study, and further remarks will be made in due course. But the meridians of distribution and the provinces of endemism can be advantageously used in our accounts of the geographical distribution of the genus.

1. *Grex RHIZOPHYLLUM*

This alternate-leaved group seems in all probability the oldest group within the genus, and its Circumpolar origin is almost definitely traceable. The group is subdivided into two subgroups as following:

1) Subgrex EURHIZOPHYLLUM—Presumably earliest of emergence, this subgroup embraces now more than ten series within its scope.

1) We have just received the twenty-second volume of Flora URSS which contains a number of new *Pedicularis* species, which for want of adequate time, are not included here in the geographical distribution, but will be considered later on in the systematic treatment.

The initial ser. *Hirsutae-verae*¹⁾ is represented by four anodontous species in the Arctic Circle. *P. flammea* L., *P. hirsuta* L. and *P. lanata* Cham. et Schl. are three species less widely distributed. The first is found from Greenland down through Labrador to part of northern Rockies in the west, to Newfoundland and Iceland in the south in the Nearctic region; in Palearctic, it is found in Lapland and Scandinavia. The second and the third frequent besides Arctic Europe and Arctic America, are also seen in Arctic Siberia. The responsibility in the diffusion and evolution of the group was, however, largely shouldered by their most prolific ally, *P. Oederi* Vahl, a species which occupies the widest geographical area. It is distributed in the Arctic America,²⁾ Arctic and alpine Europe and Arctic and alpine Siberia. Due perhaps to less variable environmental conditions, the species kept and still keeps remarkably true to its original form in Europe and northern Asia. Only one related species, *P. Albertii* Regel, was casted off in Turkestan en route to the western Himalayas. On reaching North China and Japan, however, the species began to show its instability by giving rise to several forms as subsp. *yezoensis* Nakai, var. *heteroglossa* Prain, etc. But the really serious work of evolution was not earnestly begun until the species had reached southwestern China. Beside casting an off-shoot in the ser. *Corydaloides* with two species, *P. corydaloides* H.-M. of northwestern Yunnan and southern Sikiang³⁾ and *P. cryptantha* Marq. et Shaw of western Sikang and southeastern Tibet (subsp. *erecta* Tsoong), and a few affinities as *P. angustiflora* Limpr. f. of Sikang, *P. orthocoryne* Li of northwestern Yunnan, the species, in pursuing its own main course, developed into the bidentate ser. *Pseudo-Oederianae*. The series just named contains two species, *P. pseudoversicolor* H.-M. and *P. habachanensis* Bonati, both of them inhabiting northwestern Yunnan. The next series with a characteristic multidentate corolla is *Rhynchodontae* with the monotypic *P. rhynchodonta* Franch. of northwestern Yunnan, Sikang and southwestern Kansu. Immediately behind followed the slightly longer-

1) Our presentation here is in concord with the arrangement in the phylogenetic schima in the first submission of this manuscript, wherein I have put *Hirsutae-verae* at the initiating end of *Eurhizophyllum*. This means that the scope of the series holds all the species with centrifugal inflorescence, i. e., *P. flammea* L., *P. Oederi* Vahl, *P. angustiflora* Limpr. f., *P. orthocoryne* Li, *P. Albertii* Regel, *P. hirsuta* L. and *P. lanata* Cham. et Schl. as against ser. *Hirsutae-centripetae* whose sole constituent, *P. Landsdorffii* Fisch., has centripetal inflorescence. After long meditation on the fact that the last two species possess not only somewhat different general features, but have, at least one of them, two colpate pollen grains, I am now ready to accept Prain's view to distinguish these two species into *Hirsutae-verae*, to be separated from *Flammeae* which holds *P. flammea* L. and its four true allies. Under such view-point, the relationship between these three series and their respective lines of descendents would become the following: *Flammeae* ancestral to *Eurhizophyllum*, *Hirsutae-verae* ancestral most likely to *Eu-apocladus* (*Foliosae*) and *Hirsutae-centripetae* ancestral to *Cladomania* (*Palustres*). It follows that *Hirsutae-verae* at the beginning of the present subgroup should be changed into *Flammeae*, and *Hirsutae-verae* should be, in turn, transferred to the beginning of *Eu-apocladus*, whose center of origin would also change from the European Province to the Circumpolar.

2) Cf. Limpricht, p. 202.

3) The southwestern Province Sikang has been amalgamated into Szechuan recently, but for the convenience of writing, the old name of Sikang has been retained in this paper.

beaked *Filiculae*, a series with some seven species, namely, *P. Potaninii* Maxim. of southern Kansu, *P. Lecomtei* Bonati, *P. filicula* and *P. tsangchangensis* Franch. of northwestern Yunnan, *P. filiculiformis* Tsoong and *P. takpoensis* Tsoong of southwestern Sikang and *P. Wallichii* Prain of eastern and central Himalayas.

The following series *Macrorhynchae* marks another side-development by having a corolla simulating those of ser. *Excelsae* with small lip and exceedingly long beak. It is monotypic; *P. macrorhyncha* Li being a native of northwestern Yunnan. Evolved from *Filiculae*, the bigger-flowered Ser. *Robustae* is exclusively of eastern and central Himalayas; *P. nepalensis* Prain is found in eastern Nepal and Sikkim, *P. Daltoni* Prain, *P. robusta* Hk. f. and *P. Garekeana* Prain only in Sikkim Himalaya. Next comes ser. *Macranthae*, embracing four species and a number of forms. Its range extends from southern Sikang and northwestern Yunnan where inhabits *P. insignis* Bonati, to Upper Burma in the south, the home of *P. nobilis* Bonati, through southern Tibet, Sikkim and Nepal, the native land of *P. Scullyana* Prain, to Kumaon, the westernmost point reached at present by the series and the seat of *P. Klotzschii* Hurus. (*P. macrantha* Klotz.). *Pumilliones*, most probably arising from *Robustae*, is a small series of two species and a horde of forms. *P. Przewalskii* Maxim. in its typical form and various subspecies occupies an area from southern Kansu and northeastern Chinghai, through Sikang to northwestern Yunnan in the east and southern Tibet (Phari in the eastern Himalaya) in the west. *P. bella* Hk. f. is more westerly in range; it inhabits Sikang, the Sikkim Himalaya and western Tibet.

As its name implies, *Longiflorae* is a series whose constituents are highly specialized, long-tubed species. It is the most prosperous series of the subgroup, being furnished with no less than twenty-two species, and is also considerable extent in area. The center of origin seems to be in an area comprising northern Chinghai, central and southern Kansu and northern Szechuan where one mainly finds species possessing yellow flowers with uncontorted galea as *P. bidentata* Maxim., *P. armata* Maxim., *P. cranulopha* Maxim., *P. decorissima* Diels, *P. chinensis* Maxim. and *P. longiflora* Rudolph. Among these species, *P. decorissima* and a form of *P. cranulopha*, the var. *longicornuta* Prain are also seen in Sikang while *P. chinensis* and *P. longiflora* are two wide-ranging species; the former extending eastward to Shansi and Hopei and the latter, besides being also found in the latter province, further ranging northward to Sayan, thence through the Khangai Mts. to the vicinities of Lake Kossogol, Baical and Transbaical. Southward, its area is further extended by its subsp. *tubiformis* Pennell through Sikang and Yunnan to enter and disperse westward all along the massive Chain and ultimately to find its present westernmost outpost at Baltistan in the western Himalayas.

The great number in the red-coloured and contort-galeate species in Sikang and northwestern Yunnan indicates that the series has its maximum development in this general area. Altogether thirteen species are accounted, of which, all but three are red-coloured. Six of these species, viz.

P. Croizetiana Li (yellow-flowered), *P. Paxiana* Limpr. f. (white-flowered), *P. tenuituba* Li, *P. variegata* Li, *P. leptosiphon* Li and *P. latituba* Bonati are found in Sikang with the last also discovered more lately in Bhutan; four more species, *P. humilis* Bonati, *P. dolichantha* Bonati, *P. fastigiata* Franch. and *P. sigmoidea* Franch. are the inhabitants of northwestern Yunnan, while still three more, *P. Garnieri* Bonati (yellow-flowered), *P. Delavayi* Franch. and *P. dolichosiphon* Li are species common to both these two provinces. More westerly, *P. siphonantha* Don replaces *P. Delavayi* Franch. of Yunnan in Sikkim and eastern Nepal. Two more species complete the list of the series, namely, *P. Hookeriana* Wall. in the central and western Himalayas from Nepal to Simla and *P. punctata* Decne. in the western Himalayas from Bashahr to eastern Afghanistan.

The last series, *Megalanthae*, is more westerly in range generally. *P. pauciflora* Pennell and *P. megalantha* Don are of the eastern Himalayas, the former being only found in Bhutan and Sikkim and the latter from Bhutan to eastern Nepal. The other species are western Himalayan, *P. Hoffmeisteri* Klotz. being from Kumaon to Chamba, *P. elephantoides* Benth. from Kashmir to Hazara and *P. bicornuta* Klotz. from Tehri to as far as eastern Afghanistan.

2) Subgrex RHIZOPHYLLIASTRUM—This subgroup had apparently evolved from the foregoing one, differing only in the few-flowered, usually centripetal inflorescence. Closely allied species are seen in two separate meridians, the European and the Siberian, both in most probability having descended from the wide-spread *P. Oederi* Vahl. The first unit, ser. *Roseae*, consists of three species; *P. rosea* L. and *P. orthantha* Griseb. are mainly seen in the alpine regions of the Balkan Peninsula, with the former also found in the West Alps; *P. muscoides* Li is of Sikang and southern Tibet. This anodontous series is followed by the bidentate ser. *Merrillianae*, with a single species, *P. Merrilliana* Li of southwestern Kansu, eastern Sikang and Bhutan, apparently having improved directly from *P. muscoides* Li. In Europe, such link between the "Anodontae" and "Rhyncholophae" is missing.

The succeeding series is the beaked *Asplenifoliae* which is composed of seven species. Among these, *P. geminata* Portenschl. and *P. asplenifolia* Florke are of East Alps, while *P. tsarungensis* Li, *P. Meyana* H.-M., *P. umbelliformis* Li and *P. Yui* Li are of Sikang and northwestern Yunnan. One single species ranges more southwesterly is *P. longipedicellata* Tsoong of Bhutan. With dubious systematic position here is the monotypic ser. *Odontophorae*, whose *P. odontophora* Prain is found in Sikkim and adjacent Tibet. *Paucifoliatae* is a series constituted by six species, four out of which are confined to northwestern Yunnan, viz. *P. tsangchanensis* Franch., *P. Forrestiana* Bonati, *P. yunnanensis* Franch. and *P. micrantha* Li. The other two species are *P. microcalyx* Hk. f. and *P. pseudoheydei* Tsoong, the former inhabiting southwestern Sikang, southeastern Tibet and Bhutan, and the latter being an endemic of Burma. The two series which follow *Paucifoliatae* are the monotypic *Mychophilae* of southwestern Sikang and *Franchetiana* in its typical and several forms found in southwestern

Szechuan, eastern Sikang, and northwestern Yunnan.

The big-flowered *Pseudomacranthae* is a series of three species, two of which, *P. aschistorhyncha* Marq. et Shaw and *P. Fletcheri* Tsoong are localized in southwestern Sikang, while the third, *P. Elwesii* Hk. f. with its several forms extends from northwestern Yunnan through southern Sikang and the eastern end of the Himalayan Chain to Sikkim and southern Tibet. Ser. *Albiflorae* is farther west in range. Beside *P. tapaoensis* Tsoong of eastern Sikang, seven species are to be counted in the general area comprising Upper Burma, southern Sikang, Bhutan, Sikkim and neighbouring Tibet; they are: *P. rhizomatosa* Tsoong, *P. perpusilla* Tsoong, *P. Hicksii* Tsoong, *P. petrophila* Li, *P. Tayloriana* Tsoong, *P. Regeliana* Prain and *P. albiflora* Prain. Discounting the above-named, two more species are Nepalese; they are *P. Cooperi* Tsoong and *P. pseudo-regeliana* Tsoong. Finally, there is the twist-hooded, long-beaked and long-tubed *Neolatitubae*, greatly advanced form from *Mychophilae* and *Franchetianae*; it holds a single species endemic in eastern Sikang.

2. *Grex* DOLICHOPHYLLUM

This opposite-leaved group is subdivided into four small subgroups as the following:

1) Subgrex EUDOLICHOPHYLLUM—This subgroup is nearer to *Eurhizophyllum* than all three other subgroups within *Dolichophyllum*. It is composed of two series, the bidentate *Cernuae* and the rostrate *Tatsienenses*, each containing two species; *P. cernua* Bonati and *P. myriantha* Li of the former and *P. tatsienensis* Maxim. of the latter are confined to southern Sikang and northwestern Yunnan, while the second species of the latter, *P. chenocephala* Diels, has its area more northward, being in southwestern Kansu and northwestern Chinghai.

2) Subgrex BRACHYSTACHYS—This subgroup seems to be more akin to *Rhizophylliastrum*, being also dwarf plants of very high altitude. The bidentate ser. *Collatae* holds two species, *P. Bietii* Franch. and *P. collata* Prain, the former inhabiting Sikang and the latter taking its abode in Bhutan and Sikkim. The second rostrate ser. *Pseudoasplenifoliae* is composed of *P. schizorhyncha* Prain and *P. exigua* Li, two species limited to Sikkim Himalaya.

3) Subgrex DOLICHOPHYLLIASTRUM—This third subgroup consists of three series, *Atrovirides*, *Remotilobae* and *Sikkimenses*. The first series with the bidentate *P. atroviridis* and *P. Sherriffii* Tsoong, is exclusively of southwestern Sikang. The second with its sole constituent, the short-beaked *P. remotiloba* H.-M. is only seen in western Yunnan. The three longer-rostrate species of the third series are slightly broader in area; *P. atuntsiensis* Bonati is of northwestern Yunnan, *P. Elliotii* Tsoong is of southwestern Sikang and *P. sikkimensis* Bonati, besides inhabiting the same area as the last species, is also found in Sikkim Himalaya.

4) Subgrex DOLICHOSTACHYS—Three series, *Pilostachyae*, *Tantalorhynchae* and *Meteororhynchae* combine to form this subgroup. The first with the toothless *P. pilostachya* Maxim. and *P. ternata* Maxim. has

its area in Chinghai and Kansu (incl. Alaschan region of the old Ninghsia province). *P. tantalorhyncha* Franch. of the second series with moderate beak is found in northwestern Yunnan with its close ally *P. tantalorhynchoides* Tsoong in southwestern Sikang. The most specialized, long-beaked *P. meteororhyncha* Li of the third series is confined to the Likiang Snow range.

3. *Grex* BRACHYPHYLLUM

The components of this opposite-leaved group fall into two natural subgroups as follows:

1) Subgrex EUBRACHYPHYLLUM—This subgroup is formed by four series; they are the bi- and multi-dentate *Lyratae*, the moderately beaked *Brevifoliae* and *Debiles* and the long-beaked *Integrifoliae*. The seven species of *Lyratae* are *P. stenocorys* Franch. and *P. polyodonta* Li of southeastern and eastern Sikang, *P. laxispica* Li and *P. tomentosa* Li of northwestern Yunnan and *P. cymbalaria* Bonati, *P. deltoidea* Franch. and *P. lutescens* Franch. (in several forms) of both Sikang and Yunnan. Only one species is found slightly to the west; it is *P. lyrata* Prain of southern Tibet (eastern Himalayas). Ser. *Brevifoliae* contains six species, of which, *P. verbenaefolia* Franch., *P. Smithiana* Bonati and *P. Tsaii* Li are of Sikang and northwestern Yunnan, *P. burmanica* Bonati is of Upper Burma and *P. porrecta* Wall. and *P. brevifolia* Don are of Himalayas from Sikkim in the east to Kashmir in the west. No less than fifteen species constitute the ser. *Debiles*. *P. debilis* Franch., *P. Maxonii* Bonati, *P. lamioides* H.-M. and *P. villosula* Franch. are circumscribed to northwestern Yunnan; *P. rotundifolia* C.E.C. Fisch. is endemic in Upper Burma. *P. confertiflora* Prain, the Himalayan form of *P. villosula*, is seen in southwestern Sikang, southern Tibet and Sikkim. Other eastern Himalayan species are *P. sphaerantha* Tsoong of southwestern Sikang, *P. inconspicua* Tsoong of Bhutan, *P. tenuicaulis* and *P. chumbica* Prain of southern Tibet, and *P. instar* Prain of Sikkim. In the central Himalayas, two species, *P. domzeyensis* and *P. Poluninii* Tsoong, are found in Nepal. Finally the westernmost point are occupied by *P. Heydei* Prain and *P. canescens* Tsoong, two species inhabiting Penjab and Kashmir respectively. The climax series *Integrifoliae* with a single species in two geographical forms are seen in Sikang and northwestern Yunnan in the east, and Sikkim and southern Tibet in the west.

2) Subgrex BRACHYPHYLLIASTRUM—This subgroup holds three series, *Binariae*, *Pectinatiformes* and *Urceolatae*. The monotypic, short-beaked *P. binaria* Maxim. of the first series is an endemic of northern Szechuan. The longer-rostrate *P. pectinatiformis* Bonati of the second series is a native of eastern Sikang while its possible progenitor, the shorter-beaked *P. Komarovii* Bonati, being reported without precise locality, is presumed to come approximately from the same general area. Two species unite to form the long-tubed ser. *Urceolatae*; they are *P. urceolata* Tsoong of eastern Sikang and *P. xylopoda* Tsoong of Bhutan.

4. *Grex* APOCLADUS

This is one of the most flourishing groups of the genus and is alternate-leaved. Its members fall into two subgroups as follows:

1) Subgrex EU-APOCLADUS—This subgroup begins with elate species of ser. *Foliosae*¹⁾ having anodontous corolla, being possible descendents of the European species of ser. *Roseae*. Seven species are counted in the Eurasian continents. In European meridian, *P. foliosa* L. occupies the West Alps, the Pyrenees and adjacent northern Spain, *P. sumana* Spreng. is dispersed in the East Alps and Apennines, while *P. Wilhelmsiana* Fisch., *P. condensata* M. Bieb. and *P. atropurpurea* Nordm. inhabit the Caucasus, Transcaucasus and Pontus in Asia Minor. In the Siberian meridian, only one species, *P. sajanensis* Steph. was recorded from southern Siberia.

To the succeeding, bidentate series, *Comosae*, more than thirty species are accredited. Its center of origin is apparently to be found in the same general area as that of ser. *Foliosae*, but by zonal distribution, its members had extended their area far and wide to the greater portion of the Eurasian Continent. A secondary center was formed later in the Altai-Tianshan Ranges where are to be found now a greater number of species than in its center of origin in Europe. The most broadly ranging species is the one that bears the serial name. Its area begins from the westernmost point in Sierra Nevada on the Iberian Peninsula. Northeastward, it passes through the Pyrenees, the Auvergne and the French Alps to West and North Italian Alps, thence a secondary line of dispersion extends south-eastward to the Apennines, but the main line still continues it eastward course through the Dinaric Alps in Yugoslavia, Taurus, Pontus to Armenia and Georgia. Northward through Middle U.S.S.R., it comes to the Urals; southward, it also extends to northern Iran. In East Siberia, its area begins from the territory along River Lena down to Baikal, whence it extends eastward through Transbaikalia to Heilunkiang (River Amur) as its easternmost point of distribution. Southward from Baikal, it extends to Lake Kossogol and again westward to Altai.

Of the remaining species, about eleven of them are represented in Europe, of which, only two are found some distance from the Mediterranean Basin; they are *P. campestris* Griseb. et Schenk of eastern and southern Carpathians and the neighbouring Ukraine and northern Rumania and *P. daghestanica* Bonati of Caucasus. Besides these, two of the remainder keep a more westerly range, i.e., *P. schizocalyx* Lange of Castile and *P. asparagoides* Lapeyr. of Catalonia and Pyrenees. The other seven species are *P. graeca* Bunge, *P. Ferdinandii* Bornm., *P. heterodonta* Panc, *P. moesiaca* Stadl., *P. leucodon* Griseb., *P. Fridrici-Augusti* Tommas and *P. petiolaris* Ten. The headquarters of these species is in the Balkan Peninsula, including an area from Greece in the south, Thrace in the east, through Bulgaria, Albania and Yugoslavia to Istrian Peninsula, although the first and the second are more restricted in range, being found only in

1) Cf. footnote under subgroup *Eurhizophyllum* in page 44.

Greece and Macedonia respectively, and the last two species extend also to Latium and Apennines in Italy.

Eighteen more species are to be found in Asia, although among them some are shared by Europe. Circumscribed in or around the apparent second center of area of the series in Turkestan and Altai-Tianshan Ranges, are a number of species comprising *P. altaica* Steph., *P. Fetchenkoi* Bonati and *P. Krylowii* Bonati of Altai and Kirghiz, *P. brevifolia* Regel of Songaria and Turkestan and *T. dubia* Fetchenko of Turkestan and Pamir. Beside these species just mentioned, all the others have their areas either much broader or else far distant from the secondary center. Among these, only two species find their ranges to the south; they are *P. dolichorhiza* Schrenk from Songaria through Afghanistan to Gilgit in the western Himalayas and *P. brevirostris* Pennell of western Himalayas from Gilgit to Zaskar only. To the northeast of the secondary center, there are eight species, viz., *P. achilleifolia* Steph. from Pamir through Altai to North Mongolia; *P. uliginosa* Bunge of approximately the same area but being found further in Alatau in the west and in Baical and Transbaical in the east; *P. flava* Pall. from Turkestan through Altai, Mongolia to Transbaical; *P. rubens* Steph. from Altai through Baical and Transbaical to the Lena River territory in Arctic Siberia; *P. venusta* Schangin from eastern Altai to Kamchatka with a white-flowered form in Hokkaido; *P. fissa* Turcz., a species confined to Baical and Transbaical; *P. nigrescens* Nakai, an endemic of Chosan Peninsula and *P. apodochila* Maxim. of Honshu and Saghalin. Finally, there still left three species which disperse both eastward and westward, namely, *P. physocalyx* Bunge whose area starts from Turkestan and Altai westward through the Kirghiz Steppe to Ural and also in Arctic Siberia, *P. lasiostachys* Bunge from Altai slightly eastward to Lake Ubsa and also to Mongolia, but mainly westward in Daghestan in Caucasus and around Kiev in Ukraine and *P. laeta* Stev. recorded in the east in Altai, Songaria, northern Mongolia and in the west through Siberian Steppe to Ural, and along southern Ural to the basins of Volga and Donets in Europe.

The third ser. *Rostratae* with moderate beak, comprising some thirteen advanced descendants of the preceeding series, is almost exclusively European. Its center has apparently shifted from the Balkan Peninsula as occupied by the last series westward into the Alps from northern Yugoslavia (Croatia) through Austria, northern Italy and Switzerland to southeastern France. Here are *P. gyroflexa* Vill., *P. Barrelieri* Reichenb., *P. elongata* A. Kerner, *P. rostrata* Linn., *P. cenisia* Gaud., *P. caespitosa* Sieber and *P. tuberosa* Linn., although the last two named occur also in northern Spain. Besides these species, *P. elegans* Tenore is only of central Apennines, *P. flavissima* Gandog., *P. pyrenaica* Gay. and *P. mixta* Gren et Godr. are restricted to northern Spain, *P. Beaumgartenii* Smk. is seen in southern Carpathians and Transilvania while *P. Nordmanniana* Bunge stays in the eastern skirt of the area in Asia Minor.

Having approximately the same status in evolution as *Rostratae*, the fourth ser. *Strobilaceae* shows a discontinuous area of the subgroup in

that the four species, *P. gracilicaulis* Li, *P. strobilacea* Franch., *P. pseudocephalantha* Bonati and *P. dichrocephala* H.-M. are all endemics of north-western Yunnan without any related forms occurring in the intervening area between Yunnan and the southwest-northeast line of dispersal from Pamir to Baikal as occupied by the constituents of ser. *Comosae*. The fifth series *Oliganthae*, with somewhat longer beak is, too, mainly of north-western Yunnan, wherein inhabit *P. tahainensis* Bonati, *P. dissectifolia* Li, *P. Fengii* Li, *P. oligantha* Franch., *P. tuchenensis* Bonati, *P. cephalantha* and *P. longipetiolata* Franch., although the last two are also to be seen in adjacent Sikang. Only one species finds its home slightly to the west, and that is *P. cephalanthoides* Tsoong of Assam. The ten species that group into the next ser. *Oxycarpae* with usually contortedly beaked galea frequent an area much broader than that of the two foregoing series. Among these species, *P. subulatidens* Tsoong is of southern Tibet, *P. stenophylla* Li and *P. lanceifolia* Tsoong are of Upper Burma, *P. Stewardii* Li is of Kweichow, *P. tibetica* Franch. is of Sikang, *P. macilentia* Franch. is of northwestern Yunnan while *P. Monbeigeiana* Bonati and *P. oxycarpa* Franch. are both of northwestern Yunnan and southeastern Sikang. The last two species having a more northerly range are *P. torta* Maxim. and *P. Davidii* Franch. of southern Kansu and northern Szechuan, with the former also of western Hupeh and the latter also of southern Shensi. Three out of the four species of the seventh series *Dissectae* limit their areas in Sikang; they are *P. Souliei* Franch., *P. Petitmenginii* Bonati and *P. sparsiflora* Bonati. Slightly northeasterly is to be found the last species, *P. dissecta* Pennell et Li of southern Shensi and Honan.

The monotypic *Amplitubae*, a series with rather dubious affinity, is endemic in northwestern Yunnan. The last series, *Rhinanthoides*, holds only two species, viz. *P. cyclorhyncha* Li and *P. rhinanthoides* Schrenk; the former is of northwestern Yunnan, while the latter with its several subspecies is widely dispersed; the typical form occurring in Songaria down through Pamir to the western Himalayas and its other subspecies from Afghanistan all through the Himalayas to Yunnan-Sikang, thence to Kansu, Shensi and Inner Mongolia.

2) Subgroup PSEUDAPOCLADUS—Unlike the foregoing subgroup and also dissimilar to most of the other groups in the genus, this subgroup had scarcely evolved in the European meridian, not very much in the Siberian and Japanese meridians, but became greatly advanced and more prosperous in the American meridian, where it had further migrated southward over the equator into South America.

This subgroup, as defined, contains six series from the most primitive to the most advanced. The first series, *Limnogenae*, is a small one holding three toothless species, namely, *P. recutita* L. of the Alps from Austria to eastern France, *P. limnogenae* Kern. of Balkan Peninsula from Carpathian to northern Greece and *P. olympica* Boiss. of Mt. Olymp in western Turkey.

The second series is the bidentate *Sudeticae*. The species representing the series is now found in the Polar regions of all three meridians of

distribution, but its original haunt seems to be in the Sudetic Mts. in central Europe.¹⁾ From here the range extends to Lapland, through Kanin Peninsula, the Islands Kolguev and Novaja Zemlya to the Polar Urals. In its Asiatic extension, it dispersed itself all through the Rivers Yenisei, Olenek, Lena, Kolyma, Anadyr to the Peninsula of Kamchatka; passing over St. Lawrence Island, it enters the American meridian into Alaska and arctic Canada; along River Lena, it also extends southward to Transbaical. With this species, no relatives are seen in the European meridian, but there are one *P. laresarensis* Bornm. of southeastern Iran and five more found in the Siberio-Turkestan and the adjacent Japanese Provinces. These are *P. villosa* Ledeb. found in the general region of Rivers Lena and Kolyma (also in Sakhalin?), *P. nasuta* M. Bieb. of Okhotsk and Kamchatka, *P. Koidzumiana* Tatew. et Ohwi of Sakhalin and Hokkaido, *P. elata* Willd. from Tomsk to Transbaical and lastly *P. songarica* Schrenk of Alatau and Tianshan.

In the American meridian, *P. sudetica* Willd. dispersed itself in Alaska and arctic Canada. Southward, two close relatives emerged from this species in the Rocky Mountains; one, *P. cystopteridifolia* Rydb. is confined to Yellowstone and the other, *P. scopulorum* Gray has its area in Wyoming and Colorado.

The third series, the rostrate *Compactae*, is likewise shared by several meridians. In the European meridian, the series is only represented by a sole species, *P. incarnata* Jacq. which frequents Galicia and Pyrenees in Spain, and also the Alps from eastern France to northern Austria. In the Siberio-Turkestan Province, *P. compacta* Steph. has an extensive area, i. e., from Ural in the West, eastward to Naryn, southeastward to Sajon, whence again eastward to Baical, and southward to southern Altai and Songaria. *P. uncinata* Steph. has a much more restricted area of from southern Altai to Transbaical only. In the American Province, the two Rocky Mountain species of the previous series evolved into quite a number of species. Of these, there are *P. Hallii* Rydb. of Montana and Wyoming, *P. lunata* Rydb. and *P. anaticeps* Pennell of Wyoming alone, *P. mogollonica* Greene of Mogollon Mountains in New Mexico and *P. Parryi* Gray which has distributed from Wyoming southward to Colorado, Utah, and Arizona; in the west, it is also seen in California. In the last two States occur two

- 1) There is no doubt that *P. incarnata* Jacq. is improved from *P. recutita* L. But according to the law governing the development of the *Flammea*-typed groups, there still lacks a toothed stage between these two species, and *P. sudetica* Willd. seems to fit well into this vacancy. Moreover, the far-reaching dispersal tracks of the subgroup into South America also lead one to surmise that the ancestral stock has originated in a point situated in a comparatively warmer country, and to this, the Mediterranean Basin is certainly a logic answer.

It is to be noted further that in my discussions about hybridization (Vol. IV, pp. 141-142), I have referred *P. recutita* L. as belonging to *Rhizophyllum* and *P. incarnata* Jacq. as belonging to *Apocladus*, it is because I have formerly kept ser. *Limnogenae*, which holds the former species, in *Rhizophyllum*, and have put the latter species in ser. *Rostratae* which has its position in *Eu-apocladus*. But I have since changed my opinion, and prefer to take ser. *Limnogenae* from *Rhizophyllum* to be put at the initiating end of *Pseudapocladus*, also to bring *P. incarnata* out of *Rostratae* to be kept in ser. *Compactae* of subgr. *Pseudapocladus*, as what is seen in the phylogenetic schema.

more species, i. e., *P. similis* Heller and *P. Howellii* Gray respectively. The southernmost point is occupied by three species, each localized in a small area in Mexico; these are *P. Orizabae* Cham. et Schl. of Hidalgo, *P. Jonesii* Brand of Jalisco and *P. mexicana* Zucc. of Mexico and Oaxaca.

Two more or less affiliated but somewhat different species, *P. pedicellata* Bunge and *P. ornithorhyncha* Benth. constitute the fourth series *Ornithorhynchae*; the former inhabits Sitka and the latter has its home in Mt. Rainier of Washington.

The highest development in floral structure of this subgroup is only attained by New World species as shown in ser. *Incurvae* and *Surrectae*. The monotypic *P. incurva* Benth. of the former series is not only found in the Andes of Columbia, but coming actually over the Equator to Cuenca in Ecuador, thus surpassing *P. zeylonica* Benth. of group *Cladomania* in southward invasion. The latter ser. are constituted by three species, namely, *P. contorta* Benth., *P. attollens* A. Gray and *P. groenlandica* Retz. The area of the first species is in the Cascades of Washington and Oregon and the Rocky Mountains of Idaho, Wyoming and Montana; that of the second is located in Sierra Nevada of California. The last species, being the most wideranging among the higher elements of the subgroup is found to grow with the second species in Sierra Nevada where is most probably its center of origin. From here it finds its eastern extension in New Mexico; northwardly it ranges through the Rockies to British Columbia in the west and through Ruperts Land and Labrador in the east to become finally an immigrant of Greenland.¹⁾

5. Grex ORTHOSIPHONIA

This opposite-leaved group is one of the largest groups within the genus. To judge by the facts on hand, there must be two different centers of origin for this group. On the one hand, the concentration of a number of primitive species with anodontous corolla in the Near East suggests the Caucasian Province to be one of its centers, wherein the species had perhaps sprung either from the existing members or from some extinguished forms of the ser. *Limnogenae*. This center, though numerically superior in archaic species, is on the contrary less important in the evolutionary point of view, as the species had gained little headway in evolving into more specialized forms. On the other hand, the extreme similarity in morphology and the proximity in geographical area between *P. pycnantha* Boiss., seemingly the real progenitor of the group, and *P. Albertii* Regel, its most probable predecessor belonging to the ser. *Hirsutae-verae*, force one to take the Siberio-Turkestan Province to be the second center of origin for the group.

Systematically, this group is constituted by fifteen series. Of these, the initiating ser. *Caucasicae* contains about ten species. More than half of these species are concentrated in the Near East; these are *P. cadmea* Boiss. and *P. Jankae* Steining. of Taurus Chain in southern Turkey, *P.*

1) Cf. discussions by Prain on Greenland species in pp. 43, 44; also see discussions in "Chronology of *Pedicularis*" in next issue.

caucasica M. Bieb. of northern Turkey, Transcaucasia and West Elburz of northern Iran, *P. pontica* Boiss. of Pontus and *P. Beaugeausii* Maxim. of Armenia.

In the second center of the series, there are two species, *P. Maximowiczii* Krassn. of middle Tien Shan and *P. pycnantha* Boiss. which occupies, with its several forms, a much broader area. From its center in western Turkestan, this species distributed westward through Iran, where two more near relatives, *P. Mobayensii* Parsa and *P. Hausknechtii* Boiss. were cast off, to stop presently in its westernmost point in Kurdistan of eastern Turkey. From the same center, it also extended southward through Afghanistan, then turning southeastward to the western Himalayas to stop at Bashahr (Kunawar) where marks its easternmost point of distribution at present.

Advanced directly from *Caucasicae* is *Abrotanifoliae*, a series of more elate habit and contains about seven anodontous species. The possible stock of the series, *P. abrotanifolia* M. Bieb. is represented by two forms, var. *altaica* and var. *mongolica* of Maximowicz; the former ranges from Alatau northward to Altai, again northwestward, it is to be seen in the southern Urals; the latter, however, inhabits only the Khangai Mts. and Lake Kossogol region in Mongolia. A near relative of the first species, *P. leptorhiza* Rupr. is found in Altai, Tien Shan and Western Turkestan (Margelan). In the Koksuy Valley of Tien Shan, there appears *P. tenuicalyx* Tsoong. In southern Altai is another species, *P. moschata* Maxim., also a near ally of *P. abrotanifolia*. After these species which are more northerly in range,¹⁾ the area occupied by the remaining species are much to the south. *P. brevilabris* Franch. is of northwestern Szechuan and eastern Sikang; *P. obscura* Bonati, an endemic of northwestern Yunnan and *P. densispica* Franch., the typical form of which is of northern Yunnan, southern Szechuan and southwestern Sikang, its subsp. *Schneideri* (Bonati) Tsoong of southeastern Sikang and northwestern Yunnan. The discovery of the same subspecies in Lhasa and another form, subsp. *viridescens* Tsoong in Kongbo shows that the species is not only still extending its range westward, but is also evolving actively. In the eastern Himalayas, three small series of uncertain derivation, *Gibberae*, *Denudatae* and *Molles* are found. The monotypic *P. gibbera* Prain of the first and *P. denudata* and *P. polygaloides* Prain of the second are concentrated in the Sikkim Himalaya and immediate neighbouring Tibet. The monotypic *P. mollis* Wall. has its alpine form, subsp. *alpina* Tsoong, around Phari

1) *P. pilostachya* and *P. ternata* of Maximowicz are two species formerly kept in ser. *Abrotanifoliae*, but on the similarity of the foliage leaves and general habit with the species of *Hirsutae-verae* on the one hand, and that of *P. tantalorhyncha* Franch. and *P. meteororhyncha* Li on the other, I have combined it with these two species to form a subgroup *Dolichostachys* of the group *Dolichophyllum*. Seeing the disruption of geographical distribution of the ser. *Abrotanifoliae* — the lack of species in the intervening area (North China) between Altai-Tien Shan and northern Szechuan — it is perhaps logical to keep these two species in ser. *Abrotanifoliae* as did the other authors; in so doing, they would form with their areas (*P. ternata* Maxim.: southern Mongolia, Chinghai and western Kansu; *P. pilostachya* Maxim.: eastern Chinghai and western Kansu) a connecting link to fill up the gap in the area of the series.

in southern Tibet and its typical form extending eastward to southeastern Tibet, Bhutan and westward to Nepal.

Next comes the bidentate ser. *Sarawschanica* and *Platyrrhynchae*, comprising the advanced descendents of ser. *Caucasicae* and *Abrotanifoliae* respectively; they too, have their centers in Turkestan. Merely a step forward, *P. sarawschanica* Maxim. is almost simply a two-toothed *P. Maximowiczii* Krassn., and its location is plainly shown by its specific epithet. Out of six species of ser. *Platyrrhynchae*, only one species, *P. Strausii* Hauskn. comes from western Iran. In Turkestan, *P. pulchra* Pauls. is a species of Pamir, *P. platyrrhyncha* Schrenk is of Kirghiz Steppe, *P. Waldheimii* Bonati is of Kokand, *P. interrupta* Steph. is of Ferghana, but also extending northward to Altai and southern Altai and *P. chorgosica* Regel is of Khorgos.

The beaked forms begin from the monotypic series *Simae*, denoting a sideline development of *Abrotanifoliae*; *P. sima* Maxim. is circumscribed to western Kansu and northern Szechuan. In the west, ser. *Caucasicae* developed into a small series *Crassirostres*, containing two species, *P. Bungei* Tchihat. and *P. crassirostris* Bunge, with the latter represented by several subspecies. These are all localized in Caucasus and the Transcaucasia. In the east, the heirs of ser. *Platyrrhynchae* group into ser. *Myriophyllae*. They are seven in number, and occupy a very broad geographical area. The most widely diffused species is *P. myriophylla* Pall., *P. alaschanica* Maxim. and *P. Chamissonis* Stev. The first had probably first appeared in Songaria, from where it ranged northward to Siberian East Altai, Sayan, Lake Kossogol in northern Mongolia, Baical, Transbaical and central Mongolia; its forma *purpurea* is also found in Kossogol and Mt. Hsiao-wutaishan in northern Hopei. The second ranges from western Mongolia, Kokonor region in Chinghai to Kansu (including former province of Ninghsia); from here southward, its place is taken over by its subsp. *tibetica* Maxim. which is seen in Chinghai, Assakgol, and Lhasa, Gyantze, and Phari (eastern Himalayas) in southern Tibet. The third species, *P. Chamissonis* is also represented by two forms, subsp. *japonica* (Miq.) Tsoong and subsp. *genuina* Tsoong. The typical form begins its range from Kamchatka and Kuril Islands, eastward through the Aleutian Islands to arrive at Sitka in southern Alaska. The origin of the Japanese form is somewhat ambiguous, its present range is located in middle Honshu and midwest of Kiushu; it may be a southward extension of the typical form from the Kurils, or else evolved from *P. myriophylla* of North China independently; in both these cases, there is disruption in distribution. Beside these broad ranging species, *P. scolopax* Maxim., a near relative of *P. alaschanica*, is an inhabitant of northeastern Chinghai and eastern Kansu; *P. cristatella* Pennell et Li frequents southwestern Kansu and northern Szechuan; *P. Tatarinowii* Maxim. and *P. Provotii* Franch. are two species of North China provinces, the first is an endemic of northern Hopei and the latter is also found in Inner Mongolia and northern Shansi.

In Bhutan, we find *P. Ludlowiana* Tsoong, the type of the monotypic ser. *Ludlowianae*, the origin and affinity of which is scarcely ascertainable.

The long-beaked ser. *Gyrorhynchae* is composed of three closely allied species, *P. Duclouxii* Bonati, *P. gyrorhyncha* Franch. and *P. Wangii* Li, the first of which is of Sikang and the second and the third are of northwestern Yunnan. Comprising about eight species, the still longer-beaked *Pectinatae* seems to have improved from *P. alaschanica* subsp. *tibetica*. Its range is extended much to the west in the Himalayas. The easternmost point occupied by this series is Kongbo province in southern Tibet, the home of *P. rhynchotricha* Tsoong. Beside this species, the other seven are exclusively the inhabitants of the western Himalayas. Among these, *P. pectinata* Wall. with its several subspecies is found from Kumaon to Gilgit and Hazara, *P. tenuirostris* Benth. from Tehri to Afghan border, *P. Stewartii* Pennell from Chamba to Hazara, *P. pyramidata* Royle from Lahul to Chitral, *P. kashmirica* Pennell with its subsp. *ornata* Pennell from Baltistan to Ladakh and its typical subspecies from westernmost Tibet to eastern Afghanistan, *P. multiflora* Pennell in Kashmir and finally, *P. cyrtorhyncha* Pennell is confined to Chitral.

The last series of the group, *Semitortae*, possessing contorted galea has, on the contrary, an area much to the east and north than the preceding one. The five species of this ser. are *P. Oliveriana* Prain of southern Tibet (Phari and along the Tsangpo and its tributaries from Lhatze to Lhasa), *P. muliensis* H.-M. of Sikang, *P. Roborowskii* Maxim. of western Kansu and northern Szechuan, *P. semitorta* Maxim. of southwestern Kansu and eastern Chinghai and *P. Fetissowii* Regel of eastern Tienshan.

6. *Grex SIGMANTHA*

Seemingly to have come from different sources, *Orthosiphonia* and *Cladomania*, the constituents of this opposite-leaved group are attributable to three subgroups as the following:

1) Subgrex NOTHOSIGMANTHA—This small subgroup consists only of three series, *Cheilanthifoliae*, *Curvitubae* and *Tienschanicae*. The first series contains three species of which *P. ophioccephala* Maxim. inhabits the portion of western Himalayas in Nepal and Kumaon, *P. globifera* Hk. f. frequents Sikkim Himalaya and adjacent Tibet, being common in wet meadows along Tsangpo and *P. cheilanthifolia* Schrenk with its several forms occupies a much larger area, the typical form being found in Alatau and Turkestan, while three subspecies replace its position in the western Himalayas. In the second series, there are only two moderately beaked species, *P. anas* Maxim. of southern Kansu and northern Szechuan with its subsp. *tibetica* in Sikang and *P. curvituba* Maxim. of northern Kansu and Chinghai. Finally, the location of the monotypic, long-beaked *P. tienschanica* Rupr. of the last series is found in the western part of the mountain range which its name signifies.

2) Subgrex EUSIGMANTHA—Rather impropportionately, the members of this subgroups are distributed to three series, viz. *Plicatae*, *Verticillatae* and *Microchilae*. The two species representing the first series

are *P. luteola* Li and *P. plicata* Maxim.; the former is endemic to north-western Yunnan and the latter with its two subspecies occurs in south-western Sikang, northern Szechuan, Kansu and southern Shensi.

As a minor taxon within the genus, the second series, *Verticillatae*, seems to be the most heterogeneous in nature, as its constituents are apparently not of a common line of descent. It holds within its scope no less than thirty species. Perhaps having arisen from the members of the previous series, *P. rupicola* Franch. seems to be the most primitive species of this series. Its area, comprising that occupied by its subsp. *zambalensis*, is in northwestern Yunnan and southern Sikang. In the former locality, there are to be found five more species, i. e., *P. likiangensis* Franch., *P. brachycrania* Li, *P. glabrescens* Li, *P. lineata* Franch. and *P. Roylei* Maxim., with the one before the last occurring also in Upper Burma and Sikang and the last named one ranging all the way along the Himalayas to as far as Hazara. In-between these two extremities just referred, we have *P. nodosa* Pennell of Almora near Kumaon, *P. nana* C. E. C. Fischer and *P. rupicoides* Nakao of Nepal, *P. diffusa* Prain of Sikkim and neighbouring Tibet and *P. stenotheca* Tsoong of southwestern Sikang. To the north, Sikang, with the addition of Chinghai, northern Szechuan and Kansu forms an area wherein are to be found some fourteen species; these are *P. kansuensis* Maxim. and its subsp. *yargongensis* (Bonati) Tsoong, *P. tenera* Li, *P. Shawii* Tsoong, *P. pygmaea* Maxim., *P. Chingii* Bonati, *P. dolichostachya* Li, *P. multicaulis* Bonati, *P. daucifolia* Bonati, *P. involucrata* Tsoong, *P. flaccida* Prain, *P. szetschanica* Maxim., *P. spicata* Pall. and *P. verticillata* L. Among these species, *P. kansuensis* and *szetschuanica* have now migrated farther west approaching Tibet in range and *P. spicata* has become a common species from northern Szechuan and Kansu all through North China, Mongolia, Baical and Transbaical to the Chinese Northeastern Provinces, while *P. verticillata* has dispersed itself far and wide into a great expanse of territory far surpassing those of its kin. Its area very nearly equals to a combination of two widespread species, namely, *P. comosa* L. and *P. Chamissonis* Steven. In Asia, it starts its range from its center of origin eastward to Shensi, Hopei, southeastward across the sea to be found in southern Japan; northward, it radiates to Altai, the Ordos, Mongolia, Baical and Transbaical, the northeastern Provinces, again northward to Yalma Peninsula and the regions along Rivers Yenisei, Olenek, Lena and Kolima in Arctic Siberia; again eastward, it comes to Okhotsk and Kamchatka, thence over St. Lawrence to Sitka in Alaska; In Europe, its range is continuous from Arctic Siberia westward to Lapland and the Scandinavia, wherefrom it comes down to the Carpathians, the Dinaric Alps of Balkan, the Apennines, the French Alps, and the Pyrenees to end finally at Sierra Nevada overlooking the beach of Mediterranean. In Hupeh and eastern Szechuan, only one species, *P. holocalyx* H.-M., is found. In southern Shensi, there is *P. sparsissima* Tsoong, a close relative of *P. spicata* whose other ally, *P. Taquetii* Tsoong is an endemic of Chosan. In the northward path of *P. verticillata*, a number of affinities were evolved, these are *P. violascens*

Schrenk of Alatau, *P. anthemifolia* Fisch. of Alatau, Altai, northern Mongolia and southern Siberia, *P. eriophora* Turcz. of Kamchatka and Kurile Islands and lastly *P. amoena* Adams of the Polar Region. The mention of another species completes the list of the subgroup, i. e., *P. microchila* Franch., the monotypic form of series *Microchilae* with a strange corolla found in northwestern Yunnan and southeastern Sikang.

3) Subgrex RIGIOCAULUS—This small subgroup seems to find its closest kinship in the group *Cladomania*. It is formed by three series, *Salicifoliae*, *Rigidae* and *Ikomanae*. The sole species of the anodontous first series is restricted to northwestern Yunnan. The second series possessing bidentate corolla contains six species, of which *P. rigida* Franch. is found in southern and northern Yunnan, *P. Mairei* Bonati in northwestern Yunnan only, *P. comptoniaefolia* Franch. in southwestern Sikang, northern and northwestern Yunnan from where it further extends into Upper Burma; in the last named location occurs another species, *P. atra* Bonati. In the eastern outpost of the series is *P. rigidiformis* Bonati, being an endemic of Kweichow. The last series is again monotypic, the short-rostrate *P. Ikomai* Sasaki is an inhabitant of Taiwan Island.

7. Grex CLADOMANIA

The constituents of this prolific, alternate-leaved group are in a sense homogeneous, and no subgroups need to be introduced. The ten series which it embraces are *Hirsutae-centripetae*, *Palustres*, *Canadenses*, *Racemosae*, *Carnosae*, *Microphyllae*, *Polyphyllatae*, *Furfuraceae* and *Pseudo-erostres*. Many widely distributed species are among the constituents of this group, and they range the entire temperate complement of the Circumpolar Province.

P. Lansdorffii Fisch., the sole representative of the first series, occupies an area from Lena to Kamchatka in arctic Siberia. Then through St. Lawrence and Aleutians to arctic America, where it evolved into its bidentate var. *hians* (Eastw.) Tsoong. The second series *Canadenses* is bitypic; *P. canadensis* L. has its range from Saskatchewan and Minnetoba to Nova Scotia, thence southwestward to the Rocky Mts. of Colorado, where the second species, *P. crenulata* Benth., was originated, but its area is further extended to New Mexico in the south and Florida in the east.

Appertaining to the third series *Palustres*, there are ten species with very close affinity between them. Descended from *P. Lansdorffii*, *P. palustris* L. and *P. labradorica* Wirsing are two forerunners of the series. Most likely came into being in the Arctic Circle, the former has invaded all North, Middle and East Europe; In Asia, it is dispersed all over arctic and subarctic Siberia, thence coming down to Mongolia, Altai and Songaria. The latter species occupies a somewhat smaller area in Europe, being only found in part of Scandinavia and North Ural; in Asia, its range equals almost to that of the former, but is limited in the south by a line from Baical region through Transbaical, Amur, northern Sakhalin and Kurils. Further east, it extends from Kamchatka to Alaska, Canada, Labrador and Greenland. In the European meridian, *P. palustris* gave

rise to four species, *P. sylvatica* L., *P. lusitanica* Conth., *P. gredensis* Gandog. and *P. numudica* Pomel. The first, being more diffuse, is found from northern Europe down to South Alps; the second and the third are found in the Iberian Peninsula while the fourth has come down to Algeria to be the sole species of *Pedicularis* found in Africa.

In eastern Siberia, one more species besides *P. labradorica* is found, namely, *P. adunca* M. Bieb.,¹⁾ whose path of migration began from Kamchatka southward along the shores of Okhotsk Sea to invest finally the Island of Sachalin. In America, there are two species other than *P. labradorica*; they are *P. macrodontis* Richards. of Hudson Bay and *P. angustifolia* Benth. of southwestern Chihuahua in Mexico.

The fourth series *Racemosae* holds but a few beaked species, yet geographically it occupies an enormous area. An interesting transitional form is *P. lapponica* L., connecting *Hirsutae-centripetae* and *Palustres* to the other members of *Racemosae*. Its Area is holarctic, beginning from Dovrefield in Norway in the west to Anadyr and Kamchatka in the east on the Eurasian Continents, with its southern limit in Mongolia at present; in America, it is found in Labrador and Greenland. Apparently having evolved from *P. lapponica*, there are three widely dispersed species. On the Eurasian Continent, it is *P. resupinata* L. and its various subspecies and allies that are now flourishing. The typical subspecies has its area starting from Yakutsk on River Lena; eastward it extends to Kamchatka, herefrom southward through the Kurils to Hokkaido and Honshu in the Japanese meridian where a close ally, *P. yezoensis* Maxim. was evolved; southwestward, it also disperses along the beach of Okhotsk and the Stenovoi to Amur Region, the northeastern provinces and the Peninsula of Chosan; southward from Yakutsk, it likewise passes along the Yablonovi to Baical and Transbaical; from here westward, it ranges all through Sajon, Altai, Tomsk, crossing the Ural to reach at present the Kama River region in eastern Europe; from Baical region southward, it passes Mongolia, the Chinese Inner Mongolia, and the North China Provinces to stop, after crossing the Tsingling Range where its var. *galeobdolon* (Diels) was generated, at present in the Central provinces of Szechuan, Hupeh and Anhwei. The southernmost limit of this species is in Kweichow and Kwangsi where it presents itself in the form of subsp. *crassicaulis* (Vnt.) Tsoong.

In the American meridian, two other species held sway, i. e., *P. racemosa* Dougl. which is found from British Columbia southward to North California, and *P. lanceolata* Michx. which is distributed in eastern Canada and eastern United States.

Ser. *Carnosae* with its peculiar nigrescent habit and the strongly cuneate-lipped flower simulating *Tristes*, now replaces *Racemosae* in the southern range of the group. Its center is in the area of Yunnan and Kweichow wherein occur seven species, namely, *P. nigra* Bonati, *P. kouytschenensis* Bonati, *P. Gagnepainiana* Bonati, *P. Tsiangii* Li, *P.*

1) As Rees Cyclopaedia is not available in our library, I am not able to know by recollection where is the location for *P. parviflora* Smith.

crenularis Li, *P. crenata* Franch. and *P. veronicifolia* Franch., with the last named one found also in southeastern Sikang. From this center, *P. bifida* Pennell takes to the west all through eastern and central Himalayas to Kangra in western Himalayas, beside being found in the Khasia Mts. in Assam; southwestward, two species, *P. Colletii* and *P. corymbosa* Prain were evolved in Upper Burma; in the southeast, *P. Euvardii* Bonati is the sole species of Indo-China. Lastly, at the southern end of Deccan and the Island of Ceylon, there is to be found *P. zeylonica* Benth., most likely a descendent of *P. bifida*.

From the turning point in ser. *Microphyllae* marked by *P. tenuisecta* Franch., the group seems to have renewed its evolution once again by switching its leaf-shape back to that of *Palustres*. The center seems still in the Yunnan-Kweichow area, where are found three species, *P. tenuisecta* Franch., *P. Labordei* Vant. and *P. Henryi* Maxim., although the two former species inhabit also adjacent southeastern Sikang and the last one has spread far and wide into Hupeh, Hunan, Kiangsi, Kiangsu, Kwangsi and Kwangtung provinces. From this center, two more species were sent out; they are *P. flagellaris* Benth. of Upper Assam and the Sikkim Himalaya, and *P. Gammieana* Prain of the latter location alone.

Closely following *Microphyllae* is the longer-beaked *Polyphyllatae* whose constituents, besides *P. Limprichtiana* H.-M. of southwestern Sikang, are all endemic to Yunnan; these are *P. Stadtmanniana* Bonati, *P. kariensis* Bonati, *P. pinetorum* H.-M., *P. grua* Franch. and *P. polyphylloides* Bonati. *Furfuraceae* is a series constituted by four species; they are *P. taliensis* Bonati of southwestern Yunnan, *P. Hemsleyana* Prain of eastern Sikang, *P. Pantlingii* Prain of Upper Burma, eastern Nepal, Sikkim Himalaya and neighbouring Tibet, and *P. furfuracea* Wall. of the latter two localities only. The monotypic *Curvipes* with *P. curvipes* Hk. f. and a subspecies frequents Assam and the Sikkim Himalaya. Last comes series *Pseudo-erostres* represented by the exceedingly long-tubed but beakless *P. Perrottettii* Benth. inhabiting Nilgiri Hills in lower Deccan.

8. Grex CYATHOPHORA

This interesting opposite-leaved group is composed of four small series, *Reges*, *Cyathophylloides*, *Superbae* and *Cyathophyllae*. The first of these series contains four bidentate species, all of them are centered in the general area of eastern Sikang and northwestern Yunnan. They are *P. cupularis* Li which belongs to the former location alone, *P. Lipskyana* Bonati and *P. thamnophila* (H.-M.) Li which are shared by both of these localities and *P. rex* C. B. Clarke with its several forms has now spread from this center to Upper Burma and part of the eastern Himalayas in the west and Kweichow in the east, a fact denoting an active migration of the group still going on at present.

The second series is monotypic, *P. cyathophylloides* Limpricht f. with a swelled and slightly beaked galea, is a species confined to eastern Sikang. *Superbae* is the third series, and its monotypic, bigger-flowered and longer beaked *P. superba* Franch. inhabits northwestern Yunnan and neighbour-

ing southern Sikang. Finally, the two species of the highly evolved, long-beaked and long-tubed *Cyathophyllae* are *P. cyathophylla* Franch. of southeastern and eastern Sikang and *P. connata* Li of eastern Sikang only.

9. *Grex POLYSCHISTOPHYLLUM*

Being the smallest one within the genus, this opposite-leaved group is only supplied with two monotypic series at present, i. e., *Pentagonae* and *Dichotomae*. Geographically, both the bidentate *P. pentagona* Li and the moderately beaked *P. dichotoma* Bonati are restricted to the southern Sikang and northwestern Yunnan area.

10. *Grex DOLICHOMISCUS*

This alternate-leaved group is formed by two subgroups as follows:

1) Subgrex PTERIDIODES—This subgroup is founded on two series, *Pteridifoliae* and *Phaceliaefoliae*. The former is monotypic, and *P. pteridifolia* Bonati is an endemic of Mt. Omei in Szechuan. The two species that group into the second series range wider; *P. phaceliaefolia* Franch. is found in western Szechuan and northwestern Yunnan while *P. Fargesii* Franch. occupies a station to the east, being seen in eastern Szechuan and western Hupeh.

2) Subgrex EUDOLICHOMISCUS—The geographical area of this subgroup presents at its initiation some points of interest. The presence of *P. acaulis* Wulf in Europe and its close ally *P. Artselaeri* Maxim. in eastern Asia on the one hand and the absence of any related species in the intervening area on the other suggest a true case of vicarism, as its putative progenitor, *P. Sceptum-carolinum* L. has spread itself from the North Polar region to both of these areas.

Systematically, this subgroup is subdivided into six series. The first one, *Acaules*, holds three toothless species. *P. acaulis* Wulf is found in southern East Alps and the Dinaric Alps and *P. Artselaeri* Maxim. is in North China from Hopei to Shensi and western Hupeh. The latter species, unlike its European counterpart, shows its inclination to vary in its var. *wutaiensis* Hurus. and another kin, the *P. ishidoyama* Koidz. of Chosan. Following *Acaules* is the second ser. *Vagantes* whose monotypic *P. vagans* Hemsl. with beaked galea is an endemic of Mt. Omei. The third ser. *Infirmas*, with the single *P. infirma* Li denoting probably a sideline development from *Acaules*, is native to northwestern Yunnan. The fourth ser. *Longipedes* which represents the main line of descendance enlists six species within its scope; they are *P. filicifolia* Hemsl. of western Hupeh, *P. naturtiifolia* Franch. of eastern Szechuan, *P. laxiflora* Franch. of both these localities, *P. longipes* Maxim. of northern Szechuan, *P. axillaris* Franch. of Sikang and Yunnan and lastly, *P. aquilina* Bonati of the latter province only.

The name of the fifth series, *Omiianae* signifies by itself the location of a species and a subspecies it holds. The sixth ser. *Muscolae* has its center obviously in Sikang, where five out of six species, namely, *P. gracili-*

tuba Li, *P. sorbifolia* Tsoong, *P. geosiphon* Smith et Tsoong, *P. pseudomuscicola* Bonati and *P. macrosiphon* Franch. are located although the first and the last are also found in northwestern Yunnan and the last is further seen in Szechuan. The sixth species, *P. muscicola* Maxim., has the widest area of them all; its homeland reaches far out into the provinces of Hupeh, Shensi, Shansi, Kansu (now including Ninghsia) and Chinghai. The monotypic *P. batangensis* Bur. et Franch. of the seventh and the last series is confined to Sikang province.

11. *Grex* CYCLOCLADUS

This opposite-leaved group has now developed into the following three subgroups:

1) Subgrex ASTHENOCAULUS—Only two monotypic series constitute this small subgrex, i. e., the bidentate *Fragiles* and the moderately beaked and tubed *Flexuosae* (sensu stricto); the geographical areas of their monotypic species are in Assam and Sikkim Himalayas respectively with the latter also found more recently in Bhutan.

2) Subgrex BRACHYCHILUS—This subgroup is composed of three series, *Aloenses*, *Keiskeianae* and *Moupinenses* having somewhat discontinuous areas. Of the first, seven species are accounted; *P. Legendrei* Bonati is found in northeastern Szechuan, *P. Wardii* Bonati in southern Sikang, *P. aurata* (Bonati) Li, besides being found in the same locality as the last species, is also seen in northwestern Yunnan, where too, is to be found *P. aloensis* H.-M.; *P. brachychila* Li is confined to Sikkim Himalaya while *P. Petelottii* Tsoong is a species having been gathered somewhere in southern Yunnan bordering Indo-China.

With precisely the same habit as the preceding series but slightly improved corolla is the second ser. *Keiskeianae*; *P. Kusnetzowii* Komar. is an inhabitant of the region to the north of Amur in eastern Siberia, while *P. Keiskei* Fr. et Savat. lives on Honshu in central Japan.

3) Subgrex EUCYCLOCLADUS—The distribution of this subgroup is more compact and is wholly zonal. The first series with the monotypic, anodontous *P. salviaeflora* Franch. which initiates the evolution of the subgroup is in its present range restricted to Yunnan and adjacent Szechuan. Advanced from this series are *Melampyriflorae*, *Longicaules*, *Graciles* and *Coniferae*. The bidentate *Melampyriflorae*, strictly speaking, contains only three species, including *P. melampyriflora* Franch. of southern Sikang and northeastern Yunnan, *P. pseudomelampyriflora* Bonati of eastern Sikang and northeastern Yunnan and *P. floribunda* Franch. of eastern Sikang only. The beaked *Longicaules* is formed by two species only, one is *P. longicaulis* Franch. of northern Yunnan and the other is *P. Dielsiana* Bonati, the area of which is somewhere in western China but without definite locality.

The longer-beaked *Graciles* is also formed by two species, although the area occupied surpassing by far those of all other series combined. The widely dispersed form of *P. gracilis* Wall. is its subsp. *stricta* (Wall.) Tsoong which began its migration from its original center in Yunnan and

southeastern Sikang westward all through the Himalayas to Shendtoi in far away Afghanistan. En route, it casted off a near kin, *P. khasiana* Pennell in Assam and another form reflexive of its ancestral stock, *P. salviaeflora* Franch., i. e. the subsp. *genuina* Tsoong of Nepal Himalaya. Representing singly the ser. *Coniferae* is *P. conifera* Maxim., a rare species hitherto only found in western Hupeh.

12. *Grex* NEOSCEPTRUM

This group is alternate-leaved, and consists of two subgroups as following:

1) Subgrex GEOPHYLLUM—This subgroup is typified by a single series which in turn is also monotypic. *P. hirtella* Franch. with a bidentate corolla is an endemic species of Yunnan.

2) Subgrex EUNEOSCEPTRUM—Four series are embraced in this subgroup, namely, the two-toothed *Striatae*, the short- or moderately beaked *Proboscideae* and *Lachnoglossae* and the long-beaked *Recurvae*. The first series presents, as in series *Acaules* of *Dolichomiscus*, a discontinuity of areas occupied by vicarious species occurring in the American and Asiatic Continents. In the former continent, there are *P. Grayi* A. Nelson of Rocky Mts. in Wyoming, Colorado and New Mexico and *P. Furbishiae* S. Watson of Maine and neighbouring New Brunswick in Canada. In the latter continent, we have *P. striata* Pall., whose area begins from Transbaical down through Mongolia to North China provinces of Kansu in the west and Hopei in the east; and *P. mandshurica* Maxim. of eastern Manchuria and northern Chosan. These geographically distant but phylogenetically near species might have, in most probability, evolved independently and parellessly in their respective area from related ancestors near to group *Sceptrum* but influenced by *Rhizophyllum*. The second series, the rostrate *Proboscideae*, however, belongs to Siberian Meridian only, and its two species, *P. proboscidea* Stev. and *P. brachystachys* Bunge, are mainly of Alatau and Altai ranges. *Lachnoglossae*, the third series with the single representative *P. lachnoglossa* Hk. f. is dispersed from Yunnan along the Himalayas to Sikkim. The last series is also monotypic, *P. recurva* Maxim. with its subsp. *polyantha* (Bonati) Tsoong has its range in southwestern Kansu, northeastern Sikang and northwestern Yunnan.

13. *Grex* SCEPTRUM

Presumably, this is the second old group within the genus. It is separated into two subgroups as following:

1) Subgrex EUSCEPTRUM—This subgroup is embodied by no less than fourteen series, having evolved apparently from the next subgroup *Brevilabium* which is even more primitive. In the first anodontous ser. *Gloriosae*, we find one wide-ranging species; it is *P. Sceptrum-carolinum* L. whose area in Europe is from Scandinavian Peninsula and Lapland in the north to Rumania in the south; in Asia, it spreads all over arctic and subarctic Siberia to Okhotsk Sea in the east, and to North Mongolia and

the Chinese Northeastern provinces and Japan in the south, where it was differentiated into a number of affinities. They are *P. gloriosa* Bisset et Moore, *P. nipponica* Makino and *P. iwatensis* Ohwi of Island Honshu and *P. Ochiana* Makino of Island Yakushima to the south of Kiushiu. On the mainland, another one, *P. odontochila* Diels is found in the Tsingling Range. The second series is *Grandiflorae* whose sole constituent, *P. grandiflora* Fisch. finds its home in the area from Transbaical to northern Manchuria. *P. tsekouensis* Bonati of the third series is found in Sikang and north-western Yunnan. By far the most important series is the fourth one, *Tristes*, whose principal species *P. tristis* L. appeared first in eastern Siberia, from there it came down to Altai, Baical and Transbaical, whence further down to northern Mongolia and the North China provinces of Kansu and Shansi, where *P. shansiensis* Tsoong was segregated. In Central China, its position is taken over by its subsp. *macrantha* Maxim. which is distributed in Kansu, Hupeh, western Szechuan and Sikang. Further down south, there occurs another affinity *P. galeata* Bonati of northwestern Yunnan, standing for the monotypic fifth ser. *Galeatae*.

Improved directly from the last species is *P. dolichocymba* H.-M. with boat-shaped, short-beaked flower belonging to the monotypic sixth series, *Dolichocymbae*, whose area is restricted to northwestern Yunnan and southern Sikang. The seventh ser. *Rudes* is composed of six beaked descendents of ser. *Tristes*, they are *P. rudis* Maxim. of Kansu (incl. Ninghsia), and northern Szechuan, *P. decora* Franch. of northern Szechuan, *P. princeps* of Sikang, *P. Dunniana* Bonati of Sikang and north-western Yunnan, *P. Fischeri*¹⁾ Tsoong of Upper Burma and *P. Prainiana* Maxim. of southern Tibet (eastern Himalaya). Emerging from *Galeatae* is the eighth ser. *Ingentes* with shortly or moderately beaked galea. Its eight species are mainly concentrated in Sikang province, these including *P. Steiningeri* Bonati, *P. pseudosteingeri* Bonati, *P. lophotricha* Li, *P. tongolensis* Franch., *P. trichocymba* Li and *P. angustiloba* Tsoong. The other two species are *P. ingens* Maxim. of eastern Chinghai and northern Szechuan and *P. pseudoingens* Bonati of northwestern Yunnan.

The ninth series *Imbricatae* contains longer-beaked species evolved from *Rudes*, and there are four of them. Their center has shifted westward, for *P. platychila* Tsoong is an endemic of Assam, *P. imbricata* Tsoong, *P. mucronulata* Tsoong and *P. Clarkei* Hk. f. are all found in Bhutan with the last also met with in the Sikkim Himalaya, in neighbouring southern Tibet and Central Nepal. *Trichoglossae*, the tenth series, has only two species advanced from *Dolichocymbae*; they are *P. rhodotricha* Maxim. of southwestern Szechuan, southeastern Sikang and northwestern Yunnan, and *P. trichoglossa* Hk. f. which ranges from the last-named locality westward all through Sikkim and Nepal to arrive now at Kumaon in the western Himalayas. The eleventh series *Lasiophrydes* is formed by three species; these are *P. lasiophrys* Maxim. in two subspecies dis-

1) In naming the species in honor of C.E.C. Fischer, I have overlooked that the epithet is preoccupied, so I would like to give it a new name, *P. neofischeri* Tsoong. See full citation in systematic treatment (Part II).

tributed in eastern Chinghai, southern Kansu and northern Szechuan, *P. craspedotricha* Maxim. of northwestern Szechuan and *P. cinerescens* Franch. of Sikang. *Kongboenses*, the twelfth series that has come directly from *Ingentes*, contains two long-beaked species, *P. kongboensis* and *P. retिंगensis* Tsoong; the former is found in southeastern Tibet and the latter is slightly northward in range, being collected not far from Lhasa. The thirteenth series *Subsurrectae* is monotypic, and its single *P. Vialii* Franch. inhabits Sikang, Yunnan and Upper Burma. The fourteenth ser. *Excelsae* too, is monotypic, *P. excelsa* Hk. f. is a species of eastern Himalayas from Bhutan to Sikkim. The fifteenth and the last series *Kialenses* with contorted galea representing the highest advancement of the subgroup contains two species, i. e., *P. kialensis* Franch. and *P. streptorhyncha* Tsoong, both being confined to Sikang.

2) Subgrex BREVILABIUM—This subgroup must antedate the preceding one in existence, as *P. capitata* Adams seems to be the oldest species extant in group *Sceptrum* both in view of geographical distribution and morphological criteria. Its component species belong almost exclusively to Nearctic region where, curiously, it gained but little headway in evolution.

The four series that group into this subgroup are *Capitatae*, *Brevilabres*, *Tripinnatae* and *Lunares*. Included in the first series are three species, *P. capitata* Adams, *P. semibarbata* Gray and *P. centranthera* Gray. Of these, the first is broadly dispersed in arctic Siberia and arctic America. In the former region, it reaches Taimyr River in the west and Anadyr in the east, where it also extends to Kamchatka; further east, it is seen on the islands in the Bering Strait and the Aleutians, therefrom it enters Alaska and Greenland. Both the second and the third species are found much to the south in range, the former is found in Sierra Nevada of California and in Nevada to the east and the latter is seen in the Rocky Mts. of southeastern California, southern Utah, southwestern Colorado and western New Mexico.

The second series is monotypic, *P. densiflora* Benth. is restricted to California. *P. tripinnata* Mart. et. Gal. of the third series is also monotypic; it belongs to the flora of Mexico. The fourth ser. *Lunares* is the largest one in the subgroup, and contains as many as twelve species, which are all shortly to moderately rostrate. The first of these is *P. lunaris* Nakai, the only Asiatic representative of this subgroup; it is found in Chosan Peninsula. All the remaining eleven species belong to the American meridian, and they all inhabit the Rocky Mountains in the west. Only two species, *P. bracteosa* Benth. and *P. latifolia* Pennell are found outside the United States. Both of them are found in British Columbia, with the former extending eastward into Saskatchewan and again southward into Utah and Colorado, and the latter extending southward directly into Washington and Idaho. The nine other species, including *P. paddoensis* Pennell, *P. rainierensis* Pennell et Thomps., *P. atrosanguinea* Pennell et Thomps., *P. Thompsonii* Pennell, *P. Canbyi* Gray, *P. suifolia* Rydb., *P. pachyrhiza* Pennell, *P. flavida* Pennell and *P. Paysoniana* Pennell are

Table showing important points in the distribution of the groups and subgroups of *Pedicularis*

GROUPS	Subgroups	Provinces	Circumpolar	European	Sib.-Turkest.	Japanese	Amer'can	Caucasian	Tib.-Chin.	Him.-Yunn.
RHIZOPHYLLUM	Eurhizophyllum		+	±	±	±			x	x
	Rhizophyllastrum			+	(x)				+	x
	Eu-Apocladus		+	(?)	(x)	±			x	x
	Pseudapocladus			+	x		x			
CLADOMANIA			+	(x)	x	±	x		x	x
DOLICHOMISCUS	Pteridioides								+	x
	Eudolichomiscus			+					+	x
NEOSCEPTRUM	Geophyllum								x	+
	Euroscopitrum				+		+	(x)	x	x
SCCEPTRUM	Eusceptrum		+		x	x			x	x
	Brevilabium		+	±			x		±	
DOLICHOPHYLLUM	Endolichophyllum								±	+
	Brachystachys								+	x
	Dolichophyllastrum								+	(x)
BRACHYPHYLLUM	Dolichostachys								+	x
	Eubrachyphyllum								+	x
	Brachyphyllastrum							+	(x)	x
ORTHOSIPHONIA			±		+	±		+	x	x
	Nothosigmantha				(x)				x	x
SIGMANTHA	Eusigmantha		±	±	+				x	x
	Rigicaulis				x				+	(x)
GYATHOPHORA									+	(x)
POLYSCHISTOPHYLLUM									+	(x)
CYCLOCLADUS	Ashenocaulis									+
	Brachychilus					±			+	(x)
	Eucyclocladus				±				+	(x)

* (?) signifies that the center of origin for *Eu-apocladus* might be in the Circumpolar Province, but might also be in the European Province. Cf. footnote to subgroup *Eurhizophyllum* in page 44.

Alternate-leaved

Opposite-leaved

distributed all along the Rockies in Washington, Montana, Idaho, Oregon and California.

After presenting the distribution of the various groups and subgroups, we would like to append hereby a table which will enable us to gain a more concise impression about the dispersal of major taxa in the genus in relation to each other. The signs used in this table needs some further explanation. Three signs are here used, of these, the sign of plus (+) signifies a province which is the center of origin of a group or subgroup, the sign of plus or minus (\pm) signifies a province where only one or a very few species of a given group or subgroup are represented, and finally, the sign of multiplication (\times) signifies for a province which is the center of maximum variation¹⁾ for a group or subgroup.

B. The center of origin of *Pedicularis*

Having introduced the accounts of the distribution of the species under various groups and subgroups, we may now come to think of the all important problem as to where is really located the center of origin of the genus.

As alluded to before, Prain took to the view that the tracks of migration of *Pedicularis* species followed four meridians of distribution, and these meridians of course are built upon the assumption that the Circumpolar Province is the center of origin of the genus. This view was later accepted by Bonati in 1918. Limpricht in 1920, however, rejected the view of the first proponent; instead, the Altai-Tianshan Ranges were named by him as the cradle of the genus, an opinion which received the support from Dr. Li in his latest revision. To decide which of these two conflicting views is more appropriate, we must deduce our answer from factual distributions of the various groups and subgroups. For more direct impressions, we would like to condense the above lengthy presentation into the following paragraphs:

1. That *Rhizophyllum* has its two subgroups originated in different localities, i. e., *Eurhizophyllum* was originated in the Circumpolar Province, but its improvement into morphologically higher forms, or alternatively expressed, its "evolutionary generations", were begun tardily in the Sikang-Yunnan area where the anodontous *P. Oederi* Vahl first evolved into the angulate-hooded *P. pseudoversicolor* H.-M., then into the bidentate *P. habachancensis* Bonati and the multidentate and short-beaked *P. rhynchodonta* Franch.; that *Rhizophylliastrum* was originated from the populations of *P. Oederi* Vahl separately in European and Tibeto-Chinese Provinces respectively, forming two spatially very distant centers of origin.

2. That *Sceptrum* was also generated in the Circumpolar Province; that *Eusceptrum* began its evolution in central and southwestern China where first appeared forms with boat-shaped and short-rostrate galea like

1) See detailed discussions in "The area of a species and its relation to evolution" in next issue.

P. rudis Maxim. and *P. dolichocymba* H.-M.; that *Brevilabium* had its evolution started in the United States.

3. That *Cladomania* was originated in the Circumpolar Province by the first appearance of *P. Lansdorffii* Fisch., and the group had certainly begun its segregation and evolution rather timely, as we find in Europe and Siberia, and even in the North Polar region itself, not only a number of species of the bidentate ser. *Palustres*, but also quite a few rostrate forms as *P. lapponica* L. and *P. resupinata* L. of ser. *Racemosae*.

4. That *Apocladus* was probably originated in Europe¹⁾; that subgroup *Eu-apocladus* might have descended from ser. *Roseae* of *Rhizophylliastrum*, and both the toothless *Foliosae* and the toothed *Comosae* distributed zonally through the Turano-Iranian region and Turkestan to Siberia and the latter to as far east as Japan; that *Pseudapocladus* might have been started in Europe by *Limnogenae*, and later became wide-spread through the diffusion of the great migrant *P. sudetica* L., whose offsprings thrived in Siberia and the Rocky-Andes Chain in America.

5. That *Dolichomiscus* was, like *Rhizophylliastrum*, developed in Europe and Asia independently, in the former locality by *P. acaulis* Wulff and in the latter locality by *P. Artselaeri* Maxim., both of them being presumably the descendents of *P. Sceptrum-carolinum* L.; that subgroup *Pteridioides* has its initiation in western China.

6. That the two subgroups of *Neosceptrum* were created separately; that *Euneosceptrum* was evolved in both Asia and America, represented in Siberia and United States by closely allied species belonging to ser. *Striatae*, most probably of same descension; that *Geophyllum* came into being in southwestern China.

7. That *Orthosiphonia* was probably initiated in two different centers, i. e., Caucasus and Altai-Tianshan Ranges; It is to be noted that there was a similar zonal distribution as observed in *Eu-apocladus*.

8. That the three subgroups of *Sigmantha* were not generated in the same locality, but were developed separately, although their corollal characters are similar; that subgroup *Nothosigmantha* was originated in the Siberio-Turkestan Province, partly in agreement with the range of *Eu-apocladus* and *Orthosiphonia*; that subgroup *Rigiocaulus* was originated in Himalayo-Yunnanese Province, corresponding in area with certain members of *Cladomania*; that *Eusigmantha* was originated in Tibeto-Chinese Province, likely also in Himalayo-Yunnanese Province.

9. That besides the six alternate- and the two opposite-leaved groups just mentioned which include in them ten subgroups, the remaining five groups with nine-subgroups are all opposite-leaved, and their centers of origin are exclusively in southwestern China.

From the foregoing paragraphs and the hints from the accompanying table, we learn that that part of Siberio-Turkestan Province where elevate the Altai-Tianshan Ranges is an area showing a preponderance of *Apocladus* (*Eu-apocladus*) and *Orthosiphonia*, two groups which for

1) Cf. footnote to subgroup *Eurhizophyllum* in page 44.

apparent enough reasons, can not be deemed as the most primitive within the genus. Besides the constituents of these two groups, the only presence of others are *Sigmantha* and *Eurhizophyllum*. For similar reason, we are indifferent to the few species of *Sigmantha* here found. For *Eurhizophyllum* to which we must attach prime importance for its being one of the progenitor-groups, we find here only two species, i. e., the widespread *P. Oederi* Vahl and its ally *P. Albertii* Regel. As to the other progenitor-group *Sceptrum*, not a single species is represented in this area.

Now let us see how the fact stands in the Circumpolar Province. For *Eurhizophyllum*, there are to be counted two species, *P. Oederi* Vahl and *P. flammea* L., with three more forms supposed as of hybrid origin but nevertheless still closely allied, viz., *P. hirsuta* L., *P. lanata* Cham. et Schl. and *P. Lansdorffii* Fisch. For *Sceptrum*, we have *P. capitata* Adams and *P. Sceptrum-carolinum* L. The complete absence of one ancestral group and the poor representation of the other in Altai, in vivid contrast to perfect representation of both these groups in the North Polar region tells us with precision where to find the center of origin of *Pedicularis*.

Furthermore, it is germane to remind our readers here that the evolution in floral sizes for *Rhizophyllum* is definitely progressive, i. e., the more modern the form, the bigger the flower it bears. What is true of this principle to evolutionarily different species is almost equally true to close affinities and even true to various forms under a single species. In the present case, we find in the Tibeto-Chinese and Himalayo-Yunnanese Provinces not only a profusion of large-flowered, highly specialized forms of *Rhizophyllum*, but also some bigger-corollal forms of *P. Oederi* Vahl (e.g., var. *heteroglossa* Prain, etc.). On the contrary, what we see in the North Polar region and the Alps are just ordinary individuals of *P. Oederi* Vahl identical with those found in the Altai-Tianshan Ranges; and we must not forget that *P. flammea* L. in the Arctic bears much smaller flowers than *P. Oederi* Vahl. Of course it is but logical to find larger-sized corollas in the two southern provinces, as the trends of migration and evolution are directed towards them. But if we take Altai-Tianshan to be the center of origin, then the Circumpolar and European Provinces would become, just as the southern provinces, secondary centers in the distribution of *Rhizophyllum*. Now the presence in the Circumpolar Province of the small-flowered *P. flammea* L. would become thereby a stumbling-block in the path of such a hypothesis, since it is very difficult of explanation as to why, both being equally secondary centers, the primitive *Rhizophylli* should develop bigger flowers southward but smaller flowers in the opposite direction. It is more than apparent that Altai-Tianshan served only as a favourite lodge for *P. Oederi* Vahl on its way from its initial center in the North Pole to its optimum location of development in the Tibeto-Chinese and Himalayo-Yunnanese Provinces, but nothing more.

Besides the reasoning presented above, we may try to find some further evidence in bio-statistics. Prain in his diagram 3 (distribution

by structure, page 45) compares beaked forms with beakless ones; and in such a procedure, the latter would of necessity include those derivatives possessing bidentate galea. Here is the reason why there is an inadvertent increase in the percentage of "archaic" forms in the Siberio-Turkestan Province.

To elucidate this point, an abridged table has been prepared out of the eight tables of Bonati. No effort is further made to include the species described since his time, as their exclusion will not in the least affect the accuracy of the results derived from these statistics.¹⁾

Bonati compiled his tables by dividing the genus according to the "evolutionary corolla-types" and phyllotaxy into eight sections as following:

- AA = Anodontae-Alternifoliae
- BA = Bidentatae-Alternifoliae
- RA = Rhyncholophae-Alternifoliae
- LA = Longirostres-Alternifoliae
- AV = Anodontae-Verticillatae
- BV = Bidentatae-Verticillatae
- RV = Rhyncholophae-Verticillatae
- LV = Longirostres-Verticillatae

Although we have already discarded these "evolutionary types" as a basis for our system, the above symbols which represent Bonati's sections may nevertheless serve the purpose of presenting the eight types of combinations which show by themselves the clear stages of advancement within the genus. Besides these eight signs representing the eight combinations, some other signs which are indispensable to our compilation are introduced, and they need some further explanations as following:

N = The total number of species in each province

E = The total number of endemics in each province

P = The percentage of the total number of endemics in relation to the total number of species in each province, i. e., $\left(\frac{100 E}{N}\right)$

(N) = The number of species pertaining to each of the eight combinations in each province

(E) = The number of endemics pertaining to each of the eight combinations in each province

(P) = The percentage of endemics of each combination in relation to the total number belonging to the same combination in each province, i. e., $\left(\frac{100 (E)}{(N)}\right)$

(PN) = The percentage of (N) in relation to N, i. e., $\left(\frac{100 (N)}{N}\right)$

(PE) = The percentage of (E) in relation to E, i. e., $\left(\frac{100 (E)}{E}\right)$

1) It is because all species added to the Circumpolar Province since Bonati's time appertain to primitive types while those described from other provinces belong mostly to more advanced types.

Province	N	E	P	(N)								(E)								(P)							
				AA	BA	RA	LA	AV	BV	RV	LV	AA	BA	RA	LA	AV	BV	RV	LV	AA	BA	RA	LA	AV	BV	RV	LV
Circumpolar	22	11	50	7	7	4	—	3	—	1	—	5	3	2	—	1	—	—	—	71.4	42.8	50	—	33.3	—	—	—
European	47	57	78.7	13	17	15	—	2	—	—	—	11	13	13	—	—	—	—	—	84.6	76.4	86.6	—	—	—	—	—
American	39	56	92.3	6	?	17	—	—	—	—	—	6	?	17	—	—	—	—	—	100	?	100	—	—	—	—	—
Japanese	12	9	75.0	3	2	2	—	2	—	—	—	3	2	1	—	—	—	—	—	100	100	50	—	—	—	—	100
Sibero-Turkestan	63	42	66.7	7	27	6	2	8	7	3	3	5	20	3	—	3	6	2	3	71.4	74.1	50	—	37.5	86.7	66.6	100
Caucasian	18	14	77.7	4	3	1	2	5	2	1	—	4	2	1	—	4	2	1	—	100	66.7	100	—	80	100	100	—
Tibeto-Chinese	125	98	78.4	5	3	21	27	24	8	9	27	4	1	15	22	17	7	8	24	80	33.3	71.4	81.4	70.8	87.5	88.8	88.8
Himalayo-Yunnanese	130	106	81.4	2	2	36	20	21	8	5	25	1	1	33	23	14	7	4	24	50	50	91.6	76.6	66.6	87.5	80	96

Province	(PN)								(PE)							
	AA	BA	RA	LA	AV	BV	RV	LV	AA	BA	RA	LA	AV	BV	RV	LV
Circumpolar	31.8	31.8	18.1	—	13.6	—	4.6	—	45.4	27.2	18.2	—	9.9	—	—	—
European	27.6	36.1	31.9	—	4.2	—	—	—	29.7	35.1	35.1	—	—	—	—	—
American	15.4	?	43.6	—	—	—	—	—	16.6	?	47.7	—	—	—	—	—
Japanese	25	16.6	16.6	—	16.6	—	16.6	8.3	39.3	22	11	—	—	—	22	11
Sibero-Turkestan	11.1	42.8	9.5	3.2	12.7	11.1	4.4	4.4	11.9	47.5	7.1	—	7.1	14.3	4.7	7.1
Caucasian	22.2	16.6	5.5	11.1	97.7	11.1	5.5	—	28.5	14.2	7.1	—	28.4	14.2	7.1	—
Tibeto-Chinese	4	2.4	16.8	21.6	19.2	6.4	7.2	21.6	4.1	1	15.3	22.4	17.3	7.1	8.1	24.4
Himalayo-Yunnanese	1.5	1.5	27.7	23	16.1	6.1	3.8	19.2	0.95	0.95	31.1	21.7	13.1	6.5	3.7	22.6

(Continued)

In the table, it will be seen that under N, the Circumpolar Province occupies the sixth place with a total of twenty-two species while the Siberio-Turkestan is the third with sixty three species in all. The percentage of endemism in relation to the total number of species for the former is 50%, while that for the latter is 66.7%. This apparently constitutes one of the reasons why Dr. Li regards the former as ill-defined and refuses to accept it as the birthplace of the genus (Rev. I, page 239). In examining the figures of AA under (N), we find the two provinces being equally endorsed, the numbers being 7 in both. In endemism of AA (E), the figures of the two provinces are again the same, being 5 each. The two equivalent numbers result in the third balance in (P), being both 71.4. Now if we turn to the figures under (PN) and (PE), we will at once become aware of the all high percentage shown in AA of the former province, being 31.8 and 45.4 respectively, while those of the latter province drop sharply out of all proportion, being 11.1 and 11.9 respectively. These figures show unmistakably the high endemism of the most archaic, anodontous types in the Circumpolar Province.¹⁾

Moreover, if we pay some attention to the figures of the eight combinations under (PN) which signify the percentage of the number of species on a certain level of evolution (N) out of the grand total of each province N, we will not fail to notice that the farther is a province distant from the Circumpolar, the smaller is the number of conservative forms, and simultaneously, the greater the number of advanced forms, and vice versa. Such concentric nature in the distribution of archaic types and the excentric nature in that of specialized ones certainly can not be mere fortuitous phenomena, but must denote a fact that there is maintained some natural harmony between the evolution and the distribution of the genus.

But what the above statistics offer us is mere phenomena in the distribution of *Pedicularis*, and the decision of the center of origin will largely depend upon how we interpret them. There seems to be in the field of plant-geography two current views in contradistinction to each other. The first is held by Komarov²⁾ whose method of investigation was

- 1) In this connection, we must not lose sight of the fact that in the former works of *Pedicularis*, after the decision of a hypothetical archaic type of corolla, be it a toothless or a toothed one, all species possessing such a corolla would be regarded inclusively as primitive, irrespective of what their other morphological criteria have to offer. Such is apparently not a sound way to judge the antiquity of any species. For illustration, *P. salviaeflora* Franch. can be suitably named. Though theoretically primitive by possessing an anodontous corolla, it has nevertheless infused into its very being certain sense of modernity by its annual habit, its opposite phyllotaxy, its highly ramificate stems etc. If further examples are needed, then all derivative groups and subgroups will be found replete with similar cases at their respective stage of nascency. All this mean that the value as denoted by the shape of the hood is only *relative* but not *absolute*. Even in the selfsame "Anodontae", different association with other characters may bear very different value. Now if we examine the "Anodontae-Alternifoliae" in the Circumpolar Province, it will be clearly perceptible that species primitive both in floral structures and in other respects are concentrated here.
- 2) Komarov, V. L.; Introduction to the floras of China and Mongolia (in Russian), in Bull. Bot. Gard. St. Pétersb. XXIX(1908).

summarized by Wulff¹⁾ as “disclosing the phylogenetically most primitive types, the direction of their evolution, the centers of concentration of these primitive types, the direction of their further distribution”; in brief, it is merely the orthodox school of thinking that where there is a concentration of archaic types, there is to be located the center of origin. The second is advanced by Matthew,²⁾ for whose principle we can do no better than to quote from Babcock,³⁾ “. . . radial distribution of older types from a common center accompanied by the development of more advanced types nearer the center” and “that at any one time in a large group of organisms showing close phylogenetic relations the most conservative will be found farthest from the center of origin and the most advanced, nearest the center of origin”.

It is evident that all the authors with the inclusion of the present one who had tried, or is trying, to locate the center of origin for *Pedicularis* bear in their minds the essence of the first, or the Komarovian school of thought, and the result arrived at comes naturally to rest on the Arctic Circle or the Altai-Tianshan Ranges, and nobody has ever entertained even the faintest idea in regarding the Tibeto-Chinese or the Himalayo-Yunnanese Provinces to be the center of origin for the genus. I think, at least here in *Pedicularis*, Matthew's point of view is hardly applicable to any extent.

(to be continued)

- 1) Wulff, E. V.: An introduction to historical plant geography (English translation, 1950), 36.
- 2) Matthew, W. D.: Climate and Evolution, in Ann. N. Y. Acad. Sci. XXIX(1915), 171-317; 2nd. ed., in Spec. Publ. N. Y. Acad. Sci. I(1939).
- 3) Babcock, E. B.: The genus *Crepis*, pt. I, in University of California Publications in Botany, XXI(1947), pp. 125 & 75.